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(54) **GARDEN TOOL**

GARTENWERKZEUG

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Description

TECHNICAL FIELD

[0001] Embodiments of the present invention relate to a garden tool, especially relate to a garden tool using a gasoline engine as a power source.

BACKGROUND

[0002] According to the type of power source used, garden tools can be divided into electric garden tools and internal combustion engine garden tools. In the internal combustion engine garden tools, gasoline engine garden tools are mostly used. The gasoline engine garden tools are mainly manually controlled by users' operations. For example, when a gasoline engine is cold started, since the gasoline engine is in a low temperature state, a user is required to manually draw a starter rope to run a crankshaft of the gasoline engine, and cooperatively control opening and closing of a fuel throttle and a choker of the gasoline engine at the same time. This is very demanding for users' operation skills, or there may be faults like misfire occurring with the gasoline engine. Although in the prior art a starter motor has been used to instead the starter rope, the fuel throttle and the choker of the gasoline engine are still hard to be cooperatively controlled. Moreover, a currently widely used ignition system includes a magneto, an ignitor, and a magnet mounted on a flywheel. Ignition voltage is generated by the interaction of the magnet and the magneto, and causes the ignitor to operate. However, the ignition system has following disadvantages: since ignition voltage is proportional to a rotational speed of the flywheel, when the rotational speed is relatively low, ignition power is also relatively low. Especially in the engine starting phase, due to the low rotational speed, the ignition power cannot generate a large spark required. As a result, the garden tools are difficult to be started and the users' experience is affected. In more complicated working environments, the garden tools may not always be maintained in the best working condition. When a user lacks operation experiences and skills, malfunctions are easily to be caused. Moreover, garden tools equipped with a starter motor are usually equipped with a battery pack to power the starter motor. However, the starter motor does not have to work during normal working of the garden tools, thus the battery pack is also idle during normal working of the garden tools. It can be seen that the battery pack actually adds product cost.

[0003] EP 2 128 420 A2 discloses a choke actuator operating a choke throttle valve upstream of the main throttle valve.

SUMMARY

[0004] Embodiments of the present invention are directed to providing a gasoline engine garden tool, which can be controlled easily and conveniently through a single controller The invention is defined by the independent claim 1. Advantageous embodiments are specified in the dependent claims.

[0005] According to an aspect of the present invention, a garden tool is provided, including a gasoline engine, the gasoline engine including an engine block, a fuel supply system disposed in the engine block and an ignition system disposed in the engine block;

wherein the garden tool further includes a control system, the control system including at least one sensor used for collecting a working condition signal of the gasoline engine and a single controller used for receiving the working condition signal and controlling the fuel supply system and/or the ignition system according to the working condition signals received;

wherein the fuel supply system includes:

a carburetor, comprising an intake passage;

an automatic choke control unit, comprising a choke shaft, a choke valve mounted on the choke shaft and used for closing and opening the intake passage, a choke actuator, and a choke transmission unit comprising a passive cam sleeved on the choke shaft and an active cam cooperating with the passive cam and connected to an output end of the choke actuator, wherein when the gasoline engine is started, once an ambient temperature is lower than a preset value, the controller controls the choke actuator to work forwardly to drive the active cam to drive the passive cam to close the choke valve, and once the choke valve is closed, the controller controls the choke actuator to work reversely and be reset, so that the choke actuator is disconnected from the choke transmission unit; and

an automatic fuel throttle control unit, comprising a throttle shaft, a throttle mounted on the throttle shaft and used for closing and opening the intake passage, and a locking end located at an end of the throttle shaft and cooperating with the automatic choke unit, wherein when the throttle is opened, the choke valve is also driven to open, thereby achieving linkage between the throttle and the choke valve.

[0006] In an embodiment, the control system includes a second sensor used for measuring a rotational speed signal of the gasoline engine and a third sensor used for measuring a second ambient temperature signal, the controller adjusts ignition voltage and/or an ignition advance angle according to the rotational speed signal and the second ambient temperature signal, the ignition system includes a boosting device and a spark plug connected to an output end of the boosting device, the gaso-

line engine further includes a flywheel, and the second sensor is disposed on the flywheel.

[0007] According to another aspect of the present invention, a garden tool is provided, including a gasoline engine, the gasoline engine including an engine block, a starting system disposed in the engine block, a fuel supply system disposed in the engine block and an ignition system disposed in the engine block; wherein the garden tool further includes a control system, the control system including at least one sensor used for collecting a working condition signal of the gasoline engine, an operator used for being physically operated by a user to issue a user command signal, and a single controller used for receiving the working condition signal and controlling the fuel supply system and/or the ignition system according to the working condition signals receive; wherein the controller also receives the user command signal and performs at least one of following control actions on the gasoline engine: starting, flameout, and adjusting a fuel supply amount based on the user command signal received. In an embodiment, the starting system includes a starter motor, a speed reduction unit and a clutch unit, and the gasoline engine includes a crankshaft; wherein when the gasoline engine is started, the starter motor drives the crankshaft to rotate through the speed reduction unit; wherein the clutch unit is used for one-way transmitting torque of the starter motor and is disposed between the speed reduction unit and the crankshaft; wherein the speed reduction unit is a gear set including an input gear, an output gear and at least one transmission gear disposed between the input gear and the output gear; wherein when the gasoline engine is started, an output shaft of the starter motor drives the input gear to rotate at a same speed, the input gear and the output gear meshes with each other and perform a speed reduction movement, and the output gear drives the crankshaft to rotate at a same speed through the clutch unit.

[0008] In an embodiment, the speed reduction unit further includes an energy storage member used for storing kinetic energy of the starter motor and releasing energy to the crankshaft, the energy storage member is a coil spring or a torsion spring mounted on the output gear, and a free end of the energy storage member is able to be rotated relatively to another free end of the energy storage member as the output gear being rotated.

[0009] According to another aspect of the present invention, a garden tool is provided, including a gasoline engine and a lithium-ion battery pack, the gasoline engine including an engine block, a fuel supply system disposed in the engine block and an ignition system disposed in the engine block;

wherein the garden tool further includes a control system, the control system including at least one sensor used for collecting a working condition signal of the gasoline engine and a single controller used for receiving the working condition signal and controlling the fuel supply system and/or the ignition system according to the working condition signal received; wherein the lithium-ion battery pack is connected to the controller and provides power supply for the fuel supply system, the ignition system, and the control system through the controller.

[0010] In an embodiment, the lithium-ion battery pack is detachably mounted on the engine block.

[0011] In an embodiment, the ignition system includes a boosting device, used for raising an output voltage of the power source to an ignition voltage, the output voltage of the power source is 6 V to 12 V, and the ignition voltage is 10,000V to 30,000V.

[0012] In an embodiment, the output voltage of the power source is 6 V to 12 V, and the ignition voltage is 15,000V to 30,000V.

[0013] In an embodiment, the boosting device includes multi-stage boosting modules, and the output voltage of the power source is raised to the ignition voltage by the multi-stage boosting modules.

[0014] In an embodiment, the boosting device includes a primary boosting module and a secondary boosting module, the primary boosting module raises the output voltage of the power source to 200 V-250 V, and the secondary boosting module raises the output voltage from 220V to 250V to the ignition voltage.

[0015] According to another aspect of the present invention, a garden tool is provided, including a gasoline engine and a lithium-ion battery pack, the gasoline engine including an engine block, a starting system disposed in the engine block, a fuel supply system disposed in the engine block and an ignition system disposed in the engine block;

wherein the garden tool further includes a control system, the control system including at least one sensor used for collecting a working condition signal of the gasoline engine, an operator used for being physically operated by a user to issue a user command signal, and a single controller used for receiving the working condition signal and controlling the fuel supply system and/or the ignition system according to the working condition signal received; wherein the controller also receives the user command signal and performs at least one of following control actions on the gasoline engine: starting, flameout, and adjusting a fuel supply amount based on the user command signal received; wherein the lithium-ion battery pack is connected to the controller, and provides power supply for the fuel supply system, the ignition system, and the control system through the controller.

[0016] In an embodiment, the gasoline engine includes a crankshaft, and the starting system includes a starter motor and a speed reduction unit; wherein when the gasoline engine starting, the starter motor drives the crankshaft to rotate through the speed reduction unit; wherein the lithium-ion battery pack is disposed at a side of the speed reduction unit, the crankshaft is disposed at another side of the speed reduction unit and relative to the lithium-ion battery pack, and the controller is disposed under the power source.

[0017] In an embodiment, the garden tool according further including a power section, a handle section and

a linkage section; wherein the system includes an operator used for being physically operated by a user to issue at least one user command signal, the controller is disposed in the power section, and the operator is disposed in the handle section and/or the linkage section.

[0018] In an embodiment, the operator is separated from the garden tool.

[0019] In an embodiment, the operator includes a control panel and at least two operation keys disposed on the control panel, and a convex portion is provided between two adjacent operation keys.

[0020] In an embodiment, the operator communicates with the controller through a communication wire or wireless signals.

[0021] In an embodiment, the garden tool is a handheld garden tool.

[0022] In an embodiment, the garden tool is a walk-behind garden tool.

[0023] In an embodiment, the garden tool is a backpack-type garden tool.

[0024] Embodiments of the present invention have the following beneficial effects: by controlling a gasoline engine garden tool through a single controller and using a battery pack to supply power for the controller, operation of the gasoline engine garden tool can be more convenient and more easy, and a concentrated operation device (e.g. a control panel) can be used to control the gasoline engine garden tool conveniently. The use of the controller can improve the cooperation of various systems, so that the gasoline engine garden tool can be maintained in the best working condition. For example, when the gasoline engine garden tool starting, the controller can perform unified control of a starting system, a fuel supply system and an ignition system, according to commands issued by a user and the working condition signal collected by sensors, so that optimal matching parameters can be achieved among the systems, and the parameters can be automatically adjusted according to changes of working conditions. In the prior art, since a battery pack of a prior electric start gasoline engine garden tool only supplies power for the starting system during a starting phase, and the ignition system gets power from an additional generator during a normal working phase, utilization of the battery pack is extremely low and product cost is increased. However in the present invention, a single battery pack is used to power the entire gasoline engine garden tool including the starting system and the ignition system, which improves the utilization of the battery pack and reduces the product cost.

BRIEF DESCRIPTION OF DRAWINGS

[0025]

Fig. 1 is a structural diagram illustrating a control structure of a garden tool in an embodiment of the present invention.

Fig. 2 is a structural diagram illustrating a control structure of a garden tool in another embodiment of the present invention.

Fig. 3 is a structural diagram illustrating a control structure of a garden tool in another embodiment of the present invention.

Fig. 4 is a structural diagram of a garden tool in an embodiment of the present invention.

Fig. 5 is an exploded view of Fig. 4.

Fig. 6 is a longitudinal sectional view of Fig. 4.

Fig. 7 is a transverse sectional view illustrating a structure of a gasoline engine in Fig. 4.

Fig. 8 is a structural diagram illustrating a structure of an automatic choke control unit in Fig. 7.

Fig. 9 is an exploded view of Fig. 8.

Fig. 10 is a structural diagram illustrating a structure of the automatic fuel throttle control unit in Fig. 7.

Fig. 11 is an exploded view of Fig. 10.

Fig. 12 is a structural diagram illustrating a structure of the gasoline engine in Fig. 7 in a high speed state.

Fig. 13 is a structural diagram illustrating a structure of the gasoline engine in Fig. 7 in an idling state.

Fig. 14 is a partial enlarged view illustrating a structure of the flywheel of the gasoline engine in Fig. 4.

Fig. 15 is a structural diagram illustrating a structure of a side of the gasoline engine in Fig. 4 in which the flywheel disposed.

Fig. 16 is a structural diagram illustrating a structure of a speed reduction unit of the gasoline engine in Fig. 4.

Fig. 17 is a cross-sectional view taken along line A-A of Fig. 16.

Fig. 18 is a structural diagram illustrating structures of a ratchet wheel and a clutch drum in Fig. 17.

Fig. 19 is a structural diagram illustrating a structure of an energy storage member in Fig. 17.

Fig. 20 is a structural diagram of a garden tool in another embodiment of the present invention.

Fig. 21 is a partial enlarged view of Fig. 20.

Fig. 22 is a structural diagram of a garden tool in another embodiment of the present invention.

Fig. 23 is a partial enlarged view of Fig. 22 in an embodiment of the present invention.

Fig. 24 is a partial enlarged view of Fig. 22 in another embodiment of the present invention.

Fig. 25 is a characteristic curve diagram of a prior ignition system.

Fig. 26 is a characteristic curve diagram of an ignition system in an embodiment of the present invention.

DETAILED DESCRIPTION

[0026] The invention will be described in more detail below with reference to the detailed description of embodiments shown in the drawings. However, these embodiments do not limit the present invention, based on the embodiments, any modifications, changes in structure, method or function by those skilled in the art, are within the protection scope of the present invention as

defined by the appended claims.

Embodiment **1**

[0027] According to Figs.**1** to **2** and **4** to **19,** an embodiment of the present invention provides a garden tool 1. The garden tool **1** includes a power section **11,** a linkage section **12,** a working section **13** and a handle section **14.** In an embodiment, the garden tool **1** may be a grass trimmer. Of course, in other embodiments, the garden tool **1** may be a hand-held garden tool, such as a hand-held chain saw, a hand-held blower or the like. Or, the garden tool **1** may be a walk-behind garden tool, such as a lawn mower. The garden tool **1** may also be a backpack-type grass trimmer, a backpack-type chain saws, backpack-type blowers and the like. For convenience of description, a direction along an axis of the grass trimmer and away from a user using the grass trimmer is defined as a "front" direction. The power section **11** includes a power section casing **111,** and the power section casing **111** extends forward to form the handle section **14.** An end of the linkage section **12** is connected to the handle section **14,** and the other end of the linkage section **12** is connected to the working section **13,** and a power transmission device (not shown in the figures) is included in the linkage section **12** to transmit the torque output by the power section **11** to the working section **13.** In an embodiment, a gasoline engine **2** is included in the power section casing **111.** The gasoline engine **2** includes an engine block **201,** a fuel tank **2011,** a cylinder **2022,** a piston **203,** a crankshaft **204** and a crankcase **2041.** A flywheel **243** connected to a front end of the crankshaft **204** and the structure of the gasoline engine **2** are prior arts and will not be described in detail. When the grass trimmer is in operation, fuel in the cylinder **2022** is combusted to drive the piston **203** to move, and reciprocating motion of the piston **203** is converted into continuous rotation of the crankshaft **204** by the connecting rod. The rotation of the crankshaft **204** is transmitted to the power section **11** through the power transmission device. The power unit **11** includes a cutting line or a blade, and the power transmission device transmits the rotation of the crankshaft **204** to the cutting line or the blade to perform grass cutting.

[0028] In an embodiment of the present invention, According to Fig.**1**, the grass trimmer includes a control system. The control system includes a single controller **21,** at least one sensor **22** and an operator **102.** The gasoline engine **2** further includes a starting system **23,** an ignition system **24** and a fuel supply system **25,** three of which are disposed in the engine block **201.** The sensor **22** collects at least one working condition signal of the grass trimmer, and in particular collects at least one working condition signal of the gasoline engine**2**. The operator **102** is physically operated by a user to issue at least one user command signal for controlling the grass trimmer, and the controller **21** receives the working condition signal and controls the ignition system **24** and the fuel supply system **25** according to the working condition signal received. The controller **21** also receives the user command signal and performs at least one of following control actions on the grass trimmer: starting, flameout, and adjusting a fuel supply amount, based on the user command signal received. In an embodiment, the controller **21** is disposed in the power unit casing **111,** preferably disposed on the gasoline engine**2**. In another embodiment, the controller **21** may also be disposed elsewhere in the grass trimmer. In an embodiment, the operator **102** is disposed separately from the controller **21.** Specifically, as shown in Figs. **4** to **6,** the controller **21** is disposed in the power unit casing **111,** and the operator **102** is disposed at the front end of the handle section **14.** Preferably, the handle section **14** includes a grip portion **141,** and the operator **102** is disposed in front of the grip portion **141.** The controller **21** and the operator **102** are connected by a communication wire **2012.** In another embodiment, the controller **21** and the operator **102** are equipped with wireless communication devices, and the controller **21** and the operator **102** communicate with each other through wireless signals. In another embodiment, the operator **102** is separately disposed from the grass trimmer, i.e., the operator **102** may be disposed on a separate remote control that communicates with the controller **21** through a communication wire or wireless signals. In another embodiment, the operator **102** may be an independent intelligent terminal, such as a desktop computer or a mobile terminal (like a mobile phone, a laptop, a tablet, etc.), activating a user operation instruction through a software program, and performing communication through a communication wire or wireless signals.

[0029] In an embodiment of the present invention, the grass trimmer may further include a detachably connected DC (direct current) power source **101.** Preferably, the DC power source **101** may be a rechargeable lithium-ion battery pack. A single DC power source **101** is used to power the entire grass trimmer through the controller **21.** A power supply mounting section **1111** is disposed on the power unit casing **111,** the DC power source **101** is detachably mounted to the power source mounting portion **1111,** and the DC power source **101** is electrically connected to the controller **21.** A power module **1011** is further included between the DC power source **101** and the controller **21** for regulating voltage and/or current of the DC power source **101.**

[0030] In an embodiment of the present invention, as shown in Fig. **4,** the operator **102** includes a first operation key **1021,** a second operation key **1022,** a third operation key **1023,** a fourth operation key **1024** and a fifth operation key **1025.** The first operation key **1021,** the second operation key **1022** and the third operation key **1023** may be rocker switches distributed on an upper surface of a front part of the operator **102,** the fourth operation key **1024** may be a trigger switch disposed under a rear part of the operator **102,** and the five operation keys **1025** may be a trigger switch disposed above the rear part of the operator **102** and opposed to the fourth operation key

1024. Specifically, the first operation key **1021** is a master switch, the second operation key **1022** is a start switch, the third operation key **1023** is a flameout switch, the fourth operation key **1024** is a fuel supply adjustment switch, and the fifth operation key **1025** is a fuel supply lock switch. When a user is gonging to use the grass trimmer, the master switch should be pressed firstly, so that a circuit system of the grass trimmer can be connected. Then the start switch can be pressed to make the controller **21** control the starting system to start the gasoline engine **2.** During working, the user can apply different pressures on the fuel supply adjustment switch, then the controller **21** controls the fuel supply system **25** to adjust the fuel supply amount according to the state of the fuel supply adjustment switch; when the fuel supply doesn't need to be adjusted for a long time, the user can press the fuel supply lock switch, so the controller **21** locks the fuel supply amount according to the state of the fuel supply lock switch, and the fuel supply adjustment switch could be released. To finish working, the flameout switch can be pressed to make the controller **21** stop the gasoline engine **2.** Finally the master switch can be pressed again to disconnect the circuit system of the grass trimmer.

[0031] As shown in Figs.**6** and **16** to **19,** the starting system **23** includes a starter motor **231** and a speed reduction unit 232. The starter motor **231** is disposed below the cylinder **2022** to avoid a high temperature region. The starter motor **231** includes a starter motor output shaft **2311.** The starter motor output shaft **2311** extends rearward along the axial direction of the grass trimmer and is connected to an input gear 2321 of the speed reduction unit 232. An output gear **2323** of the speed reduction unit 232 passes through a clutch unit and is connected to a rear end of the crankshaft **204.**

[0032] As shown in Figs.**16** to **17**, the speed reducing unit 232 may be multistage gears, at least including a transmission gear **2322** cooperating with the input gear **2321** and the output gear **2323** cooperating with the transmission gear **2322.** The input gear **2321** is coaxially fixedly connected with the starter motor output shaft **2311,** and the input gear **2321** is rotated at the same angular velocity as the starter motor output shaft **2311.** The transmission gear **2322** includes a first tooth section **2322a** meshing with the input gear **2321,** and a second tooth section **2322**b disposed coaxially with the first tooth section **2322**a and meshing with the output gear **2323.** The diameter of the second tooth section **2322**b is larger than the diameter of the input gear **2321,** and is smaller than the diameter of the first tooth section **2322**a**.** At the same time, the diameter of the first tooth section **2322**a is smaller than the diameter of the output gear **2323.** In an embodiment, the first tooth section **2322**a and the second tooth section **2322**b may be integrally formed. In another embodiment, the first tooth section **2322**a and the second tooth section **2322**b may be separately disposed, as long as both of which are synchronously rotated at the same angular velocity.

[0033] As shown in Fig.**17** to FIG.**18**, the clutch unit may include a clutch drum **2332** disposed on the crankshaft **204,** and a ratchet wheel **2331** contacting with or departing from the clutch drum **2332** and driven by the output gear **2323.** The clutch drum **2332** includes a disk body section which is substantially rectangular shaped, a pair of pawls **2332**a disposed on opposite corners of the disk body section, and a pair of torsion springs **2332**c respectively sleeved on the pawls **2332**a**.** The pawl **2332a** includes a pawl shaft **2332**b sleeved by the torsion spring **2332**c, and a contact surface **2332**d at an end away from the pawl shaft **2332**b. The disk body section includes a pair of partial curved faces oppositely disposed. The ratchet wheel **2331** is at least partially curved, and includes a ratchet cavity **2331**a having a circular cross section, a pair of ratchet protrusions **2331**b disposed outside the ratchet cavity **2331**a and correspondingly engaged with on the pawls **2332**a with unidirectional pressure, a fixing member disposed in a center of the cavity **2331**a and coaxially fixed to the output gear **2323,** and a gasket sleeved on the fixing member. Each of the ratchet protrusions **2331**b includes a mating face **2331**c that abuts against the contact face **2332**d**.** Preferably, the contact surface **2332**d and the mating surface **2331**c are both planar. As shown in Fig.**18,** in a clockwise direction, the ratchet protrusion **2331**b abuts against the contact surface **2332**d of the pawl **2332**a through the mating surface **2331**c; however in an anti-clockwise direction, since outer surface of the ratchet protrusion **2331**b is at least partially curved, the ratchet protrusion **2331**b and the pawl **2332**a cannot abuts against each other and consequently separated from each other.

[0034] As shown in Fig.**19,** an energy storage member is preferably included and disposed inside the output gear **2323,** and is preferably a coil spring **234,** a center of which is coaxial with a center of the output gear **2323.** The coil spring **234** can reduce impacts between components at a time of starting, so as to prolong service life of the starting system **23.** The coil spring **234** includes an inner end **2341** disposed in an inner side and an outer end **2342** disposed in an outer side. A portion between the inner end **2341** and the outer end **2342** is multi-layer winded to store or release energy, and the portion winded can be contracted or expanded. The output gear **2323** includes a receiving groove **2323**a disposed outside for receiving the outer end **2342** of the coil spring **234,** and a hook **2323**b disposed on a side of the receiving groove **2323**a and engaged with the outer end **2342** of the coil spring **234.** In another embodiment, the energy storage member may also be a torsion spring.

[0035] After the grass trimmer is started, the starter motor output shaft **2311** is rotated at a high speed to drive the input gear **2321** to rotate, the first tooth section **2322**a is rotated by gear meshing, the second tooth portion **2322**b coaxial with the first tooth section **2322**a is also driven to rotate correspondingly, and the output gear **2323** is driven to rotate by gear meshing. As the output gear **2323** is rotated, pressure is continuously applied to

the coil spring **234,** and the coil spring **234** continuously stores the kinetic energy of the motor. Once the coil spring **234** provides an elastic force greater than a resistance force provided by the crankshaft **204,** the coil spring **234** will release energy to the crankshaft **204** through the clutch unit. In this case, since the clutch drum **2332** can only be rotated in one direction, and one direction transmission is achieved to drive the crankshaft **204** to rotate, thus an electric start of the gasoline engine **2** is achieved. Once the gasoline engine **2** is started, the crankshaft **204** will be rotated at a high speed, and centrifugal force of the crankshaft **204** will disengage the clutch drum **2332** from the ratchet wheel **2331** to ensure that the high-speed rotation of the crankshaft **204** has no effect on the ratchet wheel **2331,** so that the ratchet wheel **2331** can remain stationary and the speed reduction unit **232** is ensured to be stopped. As a result, a requirement for power of the starter motor **231** is small, a structure of the starter motor **231** is simple and reliable, cost is low, and a manual starting device is not needed. Since impacts between components are reduced by the energy storage member, service life of the starting system **23** is prolonged.

[0036] In an embodiment of the present invention, the DC power source **101** is disposed behind the speed reduction unit **232,** a crankcase **2014** is included and disposed in front of the speed reduction unit **232,** both the starter motor **231** and the crankshaft **204** are connected to a front part of the speed reduction unit **232,** and the controller **21** is disposed below the DC power source **101.** By using this arrangement, a structure of the power section **11** of the grass trimmer is simplified, a shape of the grass trimmer is more attractive, and wiring is easier.

[0037] As shown in Figs.**2, 6, 14** and **15**, the ignition system **24** may include an boosting device **241** , a spark plug **242** connected to an output end of the boosting device **241,** and a second sensor **222** disposed on the flywheel **243** or the engine block **201.** In an embodiment, the second sensor **222** includes inductive elements and a Hall element disposed corresponding to the inductive elements. The inductive elements are disposed on the flywheel **243** and are magnets, the number of the inductive elements is at least two, and the Hall element is disposed on the engine block **201** and the number of the Hall element is one. In another embodiment, the Hall element may also be replaced by a photoelectric element or another component alike. There is a combustion chamber within the cylinder **202,** and the spark plug **242** is fixed to the cylinder **202** and at least partially extends into the combustion chamber. Preferably, the inductive element may include a positioning magnet **2432** for initial positioning, and a measuring magnet **2431** for rotational speed measurement. The positioning magnet **2432** is also referred to as a top dead center positioning magnet. The inductive elements are disposed in the circumferential direction of the flywheel **243.** In an embodiment, the gasoline engine **2** further includes a third sensor, and the third sensor is a temperature sensor for collecting an ambient temperature signal.

[0038] In an embodiment of the present invention, the boosting device **241** raises an output voltage of the lithium-ion battery pack to an ignition voltage to provide sufficient energy for igniting air-fuel mixture. The output voltage of the lithium-ion battery pack is **6** V to **12** V, and the ignition voltage is **10,000**V to **30,000**V**.** Preferably, the boosting device **241** may include multi-stage boosting modules. In an embodiment, the boosting device **241** includes a primary boosting module and a secondary boosting module. The primary boosting module raises the output voltage of the lithium-ion pack to **200** V**-250** V, and the secondary boosting module raises the output voltage from **220**V to **250**V to the ignition voltage. Specifically, in an embodiment, the output voltage of the lithium-ion battery pack is **6**V to **7.2** V, and the boosting device **241** firstly raises the output voltage of the lithium-ion battery pack to **220** V by using series inductance, and then raises the output voltage of **220**V to the ignition voltage, which is **15,000** V to **30,000** V

[0039] In an embodiment of the present invention, the lithium-ion battery pack is used as the DC power source **101,** a rotational speed of the flywheel **243** is detected by the second sensor **222** to determine an ignition advance angle, a current temperature is detected by the third sensor, and the controller **21** raises the output voltage of the DC power source **101** through the boosting device **241.** The controller **21** calculates the ignition advance angle and the ignition voltage currently required according to current operating conditions of rotating speed, working time, temperature and the like, and then the ignition system **24** generates an electric spark of corresponding energy through the spark plug **242,** according to an internal calculation result of the controller **21.** The electric spark causes the air-fuel mixture in the cylinder **202** to burn, so as to push the piston **203** to reciprocate, thus the grass trimmer can work in an ideal working state. This allows ignition to be achieved at a very low speed, specifically, the current temperature can be detected by a temperature sensor and the ignition voltage is raised when the current temperature is low. Meanwhile, the ignition advance angle and the ignition voltage are also controlled by the controller, the ignition process can be triggered when the air-fuel mixture in the cylinder **202** is at the highest concentration, so that a maximum spark can be generated to make the start of the gasoline engine **2** easier and higher efficient. Compared with the prior magneto technology solution, installation of a bulky magnet module on blades of the flywheel is not required, which can reduce the weight of the blades, so that the power output by the gasoline engine is less consumed on the blades and the overall efficiency of the system is improved. At the same time, the ignition advance angles at different rotational speeds can be controlled at optimal states by detecting the rotational speed in advance, so that working efficiency of the gasoline engine system at all speed states can be improved. Furthermore, by using the controller to precisely control the ignition advance

angle and voltage, when the load of the gasoline engine changes drastically, compared with the prior ignition system (as shown in Fig.**25**), the controller provided by embodiments of the present invention can adjust the ignition advance angle in time by executing program algorithm with reference to positions and rotational speeds of the flywheel measured by a sensor. The obtained relationship among ignition timing, ignition voltage and rotational speeds is shown in Fig. **26,** which makes the grass trimmer work more stable.

[0040] As shown in Figs.**6** to **13,** in an embodiment of the present invention, the gasoline engine **2** may be a carburetor type gasoline engine, and the fuel supply system **25** may include a carburetor **254,** an automatic choke control unit **251,** and an automatic fuel throttle control unit **252.** The carburetor **254** includes an intake passage **2541** with an intake port, and the automatic choke control unit **251** and the automatic fuel throttle control unit **252** are disposed on the carburetor **254.**

[0041] The automatic choke control unit **251** includes a choke shaft **2515** and a choke valve **2511** mounted on the choke shaft **2515,** and the choke valve **2511** is used to open or close the intake passage **2541.** The automatic choke control unit **251** further includes a choke actuator **2512** and a choke transmission unit connected to the choke actuator **2512,** and the choke transmission unit is mated with the choke shaft **2515.** In an embodiment, the choke valve **2511** is coaxially rotated with the choke shaft **2515,** and the opening and closing of the intake passage **2541** may also be achieved through reciprocating movements of the choke valve **2511.** The choke shaft **2515** penetrates into the intake passage **2541** of the carburetor **254** and is fixedly or detachably connected to the choke valve **2511,** so that the choke valve **2511** can be rotated coaxially with the choke shaft **2515.** The choke valve **2511** is located in the intake passage **2541** and can be used to open the intake passage **2541** to let air enter the cylinder **202.** The carburetor **254** further includes a self-locking unit used to lock the choke valve **2511** and an unlocking unit used to unlock the choke valve **2511.** Since the self-locking unit can be found in the prior art, and the unlocking unit can unlock the self-locking unit by means of refueling, which is also a prior art, structures of the self-locking unit and the unlocking unit will not be described in detail.

[0042] The choke transmission unit includes a passive cam **2514** sleeved on the choke shaft **2515,** and an active cam **2513** that cooperates with the passive cam **2514** and is connected to an output end of the choke actuator **2512.** The active cam **2513** includes an active cam axle hole **2513**b sleeved on the output end of the choke actuator **2512,** and a projection **2513**a coordinating with the passive cam **2514,** the extending direction of the projection **2513**a being parallel to the axial direction of the choke shaft **2515.** The passive cam **2514** includes a passive cam axle bore **2514**a sleeved on the choke shaft **2515.** In an embodiment, the choke transmission unit may indirectly drive the choke valve **2511** through the choke shaft **2515,** or may directly drive the choke valve **2511.** The structures of the passive cam **2514** and the active cam **2513** used in above embodiment of the present invention are simple, reliable and low-cost, however the driving manner of the choke transmission unit may also apply a belt, a chain, a hinge or a pendulum to achieve an object of the present invention.

[0043] The choke actuator **2512** may be an electric motor, a combination of an electric motor and a reduction gearbox, an electromagnetic device, or a pneumatic device. The electric motor may be a DC or AC motor workable in forward and reverse directions, also called as a servo motor. In an embodiment, a DC servo motor is preferred to achieve a small structure, large torque, and programmable control.

[0044] The choke valve **2511** and the passive cam **2514** are fixed to the same choke shaft **2515,** and are rotatable with the choke shaft **2515.** The choke shaft **2515** is installed in the intake passage **2541** inside the carburetor **254** and can be rotated. Therefore, as long as the passive cam **2514** is rotated, the choke valve **2511** can be rotated by the choke shaft **2515,** thus an air intake amount can be adjusted. When the choke valve **2511** is closed by using the passive cam **2514,** the choke valve **2511** is maintained in a closed state by the self-locking unit of the carburetor **254.** When the throttle being raised, the self-locking unit is unlocked, and the choke valve **2511** is opened. Afterwards, the choke actuator **2512,** which may be a motor workable in forward and reverse directions, can drive the active cam **2513** to rotate, and the active cam **2513** can further drive the passive cam **2514** to rotate to close the choke valve **2511.** When the gasoline engine **2** is to be started, the motor works forwardly to drive the driving cam **2513** to drive the passive cam **2514** to close the choke valve **2511.** Once the choke valve **2511** is totally closed, the motor will work reversely and reset, so that the motor is disconnected from the choke transmission unit, and the choke valve **2511** will be maintained in the closed state by the self-locking unit. After the gasoline engine **2** is started, when the throttle being raised, the self-locking unit is unlocked, and the choke valve **2511** is restored to an open state. Thus it can be seen that the entire control process above can be executed automatically.

[0045] The automatic fuel throttle control unit **252** includes a throttle shaft **2526** and a throttle **2521** mounted on the throttle shaft **2526.** The throttle **2521** is used to open or close the intake passage **2541.** The automatic fuel throttle control unit **252** further includes a throttle actuator **2522** and a throttle transmission unit connected with the throttle actuator **2522.** The throttle transmission unit is also connected to the throttle shaft **2526.**

[0046] The throttle transmission unit cooperates with an end of the throttle shaft **2526** through a throttle cable **2524,** and the throttle **2521** is rotated coaxially with the throttle shaft **2526.** In an embodiment, the throttle cable **2524** may be a substantially rigid rod. In another embodiment, the throttle cable **2524** may be a flexible rod or

wire. The throttle transmission unit includes a rack **2525** fixed to the throttle cable **2524,** and a throttle drive gear **2522**b cooperating with the rack **2525** and connected to an output end of the throttle actuator **2522.** Or, the throttle transmission unit may directly cooperate with an end of the throttle shaft 2526, which can also achieve the object of the present invention. The rack and gear transmission structure applied by the throttle transmission unit in above embodiment of the present invention is simple, reliable, and low-cost, however the driving manner of the throttle transmission unit may also apply a belt, a chain, a hinge or a pendulum to achieve an object of the present invention.

[0047] In an embodiment, the automatic fuel throttle control unit **252** further includes a rotating end **2523** and a locking end **2527** respectively located at opposite ends of the throttle shaft **2526.** The rotating end **2523** is fixed to the throttle cable **2524,** and the locking end **2527** cooperates with the automatic choke control unit **251.** When the throttle **2521** is opened, the choke valve **2511** is also driven to open, thereby achieving linkage between the throttle **2521** and the choke valve **2511.** The rotating end **2523** is at least partially arcuate and includes a plurality of fixing holes **2523**a arranged in an arc shape, wherein one fixing hole **2523**a is fastened to an end of the throttle wire **2524.**

[0048] The throttle actuator **2522** may be an electric motor, a combination of an electric motor and a reduction gearbox, an electromagnetic device, or a pneumatic device. The electric motor may be a DC or AC motor workable in forward and reverse directions, also called as a servo motor. In an embodiment, a DC servo motor is preferred to achieve a small structure, large torque, and programmable control.

[0049] The throttle **2521** is fixed to the throttle shaft **2526** and is rotatable with the throttle shaft **2526,** and the throttle shaft **2526** is mounted in the intake passage **2541** inside the carburetor **254.** When the gasoline engine **2** is in an idling state, as shown in Fig. **13,** the throttle **2521** is in a closed state. The controller **21** controls the throttle actuator **2522** to operate, and drives the throttle drive gear **2522**b to rotate by a throttle output shaft **2522**a**,** thereby driving the rack **2525** to perform linear motion, and further driving the throttle cable **2524** to perform linear motion. Since the throttle cable **2524** is connected to the rotating end **2523,** the rotating end **2523** drives the throttle shaft **2526** at the center thereof to rotate together, so that the throttle **2521** is opened. Then the locking end **2527** drives the choke valve **2511** to open and air income is increased, so that the gasoline engine **2** enters into a high speed state, as shown in Fig. **12,** and automatic control of the automatic choke control unit **251** and the automatic fuel throttle control unit **252** is achieved. In an embodiment of the present embodiment, the gasoline engine **2** further includes a first sensor **221,** which is a temperature sensor for measuring an ambient temperature. In another embodiment, the first sensor **221** and the third sensor may be integrated into one sensor. By measuring the ambient temperature through the first sensor **221** in advance, when it is started, once the ambient temperature is lower than a preset value, the fuel concentration of the air-fuel mixture inhaled into the combustion chamber will be increased, and an amount of air inhaled into the carburetor **254** is reduced. Therefore, the controller **21** controls the motor to work to close the choke valve **2511,** and, and the choke valve **2511** and the throttle **2521** are opened automatically when the gasoline engine **2** returns to normally working. It can be seen that the whole process is simple and convenient, and starting states of the gasoline engine **2** can be automatically set in various starting environments, which reduces users' intervention on the start of the gasoline engine **2,** and also reduces users' labor intensity.

[0050] Based on above specific structures, a single controller is applied by embodiments of the present embodiment to control the grass trimmer, and a battery pack is used to supply power to the grass trimmer through the controller, so that operation of the grass trimmer can be more convenient and more easy, and a concentrated operation device (e.g. a control panel) can be used to control the grass trimmer conveniently. Moreover, the use of the controller can improve the cooperation of various systems, so that the grass trimmer can be maintained in the best working condition. For example, when the grass trimmer is started, the controller can perform unified control of a starting system, a fuel supply system and an ignition system, according to commands issued by a user and the working condition signal collected by sensors, so that optimal matching parameters can be achieved among the systems, and the parameters can be automatically adjusted according to changes of working conditions. In the prior art, since a battery pack of a prior electric start grass trimmer only supplies power for the starting system during a starting phase, and the ignition system gets power from an additional generator during a normal working phase, utilization of the battery pack is extremely low and product cost is increased. However in the present invention, a single battery pack is used to power the entire grass trimmer including the starting system and the ignition system, which improves the utilization of the battery pack and reduces the product cost.

Embodiment **2**

[0051] The difference from Embodiment **1** lies in that the gasoline engine **2** of the present embodiment is an EFI (electronic fuel injection) gasoline engine. As shown in FIG. **3,** the fuel supply system **25** may include an electric fuel injector **253.** The controller **21** adjusts a fuel injection amount and an air-fuel ratio through the electric fuel injector **253,** according to the ambient temperature signal measured by the first sensor **211.**

Embodiment **3**

[0052] As shown in Figs.**20** to **21,** the present embod-

iment provides a grass trimmer using a gasoline engine. The difference from Embodiment **1** lies in that the operator **102** includes a panel, and the first operation key **1021,** the second operation key **1022** and the third operation key **1023** are flat push-button switch disposed on the panel. A convex portion **1026** is provided between the first operation key **1021** and the second operation key **1022** to prevent the first operation key **1021** and the second operation key **1022** from being pressed simultaneously.

[0053] When a user presses the panel from a top direction using a body section part (usually using a palm or a finger), if only the first operation key **1021** or the second operation key **1022** is pressed, the convex portion **1026** will not hinder the movement of the user's body section part. If the first operation key **1021** and the second operation key **1022** are pressed simultaneously by mistakes, the convex portion **1026** will hinder the movement of the user's body section part. On the one hand the first operation key **1021** and the second operation key **1022** are prevented from being pressed simultaneously, and on the other hand the convex portion **1026** may cause an unpleasant touch to user's body section part, alerting the user that this is an error operation. Due to the arrangement of the convex portion **1026,** the distance between the first operation key **1021** and the second operation key **1022** can be further reduced, thereby reducing entire area of the panel or providing more installation and operation space for other components on the panel. Normally speaking, in order to prevent two operation keys being pressed simultaneously, the distance between the two operation keys **102** is increased. For operation keys **102** generally designed to be pressed by a thumb, spacing between inner sides of the first operation key **1021** and the second operation key **1022** should be not less than **25** mm. However, since the convex portion **1026** is provided in the embodiment, the spacing between inner sides of the first operation key **1021** and the second operation key **1022** can be not less than **20** mm. Furthermore, when the first operation key **1021** and the second operation key **1022** are selected as push-button switches, the spacing between inner sides of the two can be not less than **6** mm. When the first operation key **1021** and the second operation key **1022** are selected as the rocker switches, the spacing between inner sides of the two can be not less than **12** mm. Of course, selections of the first operation key **1021** and the second operation key **1022** are not limited to above types of switches, so the spacing between inner sides of the two may also be specifically adjusted according to the types of switches selected.

Embodiment **4**

[0054] As shown in Figs.**22** and **24,** the difference from Embodiment **3** lies in that the handle section **14** of the grass trimmer in the present embodiment is a U-shaped handle mounted on the linkage section **12,** and two grip portions **141** are respectively included at both ends of the U-shaped handle. The operator **102** is disposed on one of the two grip portions **141.**

Embodiment **5**

[0055] As shown in Figs.**22** and **23,** the difference from Embodiment **4** lies in that, in the operator **102** of the grass trimmer provided by this embodiment, the fifth operation key **1025** is disposed below a side of the panel. In the present embodiment, the fifth operation key **1025** is a fuel supply lock switch.

[0056] It should be understood that although the specification is described according to the embodiments, but not each embodiment includes only one independent technical solution. The description of the specification is merely for the sake of clarity, those skilled in the art should take the specification as a whole and the technical solutions in the embodiments may also be combined, the scope of protection being defined by the appended claims.

[0057] The detailed descriptions set forth above are merely for the specific description of possible embodiments of the present invention, and are not intended to limit the protection scope of embodiments of the present invention. The invention is defined by the appended claims.

Claims

1. A garden tool, comprising a gasoline engine (2), the gasoline engine (2) comprising a fuel supply system (25) and an ignition system (24);

wherein the garden tool further comprises a control system, the control system comprising at least one sensor (22) used for collecting a working condition signal of the gasoline engine (2) and a single controller (21) used for receiving the working condition signal and controlling the fuel supply system (25) and/or the ignition system (24) according to the working condition signals received;

wherein the fuel supply system (25) comprises:

a carburetor (254), comprising an intake passage (2541);

an automatic choke control unit (251), comprising a choke shaft (2515), a choke valve (2511) mounted on the choke shaft (2515) and used for closing and opening the intake passage (2541), a choke actuator (2512), **characterized in**

a choke transmission unit comprising a passive cam (2514) sleeved on the choke shaft (2515) and an active cam (2513) cooperating with the passive cam (2514) and con-

nected to an output end of the choke actuator (2512), wherein when the gasoline engine (2) is started, once an ambient temperature is lower than a preset value, the controller controls the choke actuator (2512) to work forwardly to drive the active cam (2513) to drive the passive cam (2514) to close the choke valve (2511), and once the choke valve (2511) is closed, the controller controls the choke actuator (2512) to work reversely and be reset, so that the choke actuator (2512) is disconnected from the choke transmission unit; and

an automatic fuel throttle control unit (252), comprising a throttle shaft (2526), a throttle (2521) mounted on the throttle shaft (2526) and used for closing and opening the intake passage (2541), and a locking end (2527) located at an end of the throttle shaft (2526) and cooperating with the automatic choke unit (251), wherein when the throttle (2521) is opened, the choke valve (2511) is also driven to open, thereby achieving linkage between the throttle (2521) and the choke valve (2511).

2. The garden tool according to claim 1, wherein the control system comprises a second sensor (222) used for measuring a rotational speed signal of the gasoline engine (2) and a third sensor used for measuring a second ambient temperature signal, the controller (21) adjusts ignition voltage and/or an ignition advance angle according to the rotational speed signal and the second ambient temperature signal, the ignition system (24) comprises a boosting device (241) and a spark plug (242) connected to an output end of the boosting device (241), the gasoline engine (2) further comprises a flywheel (243), and the second sensor (222) is disposed on the flywheel (243).

3. The garden tool according to claim 1 or 2, wherein the gasoline engine (2) further comprises a starting system (23), the control system further comprises an operator (102) used for being physically operated by a user to issue a user command signal, and the controller (21) receives the user command signal and performs at least one of following control actions on the gasoline engine (2): starting, flameout, and adjusting a fuel supply amount based on the user command signal received.

4. The garden tool according to claim 3, wherein the starting system (23) comprises a starter motor (231), a speed reduction unit (232) and a clutch unit, and the gasoline engine (2) comprises a crankshaft (204); wherein when the gasoline engine (2) is started, the starter motor (231) drives the crankshaft (204) to rotate through the speed reduction unit (232); wherein the clutch unit is used for one-way transmitting torque of the starter motor (231) and is disposed between the speed reduction unit (232) and the crankshaft (204); wherein the speed reduction unit (232) is a gear set comprising an input gear (2321), an output gear (2323) and at least one transmission gear (2322) disposed between the input gear (2321) and the output gear (2323); wherein when the gasoline engine (2) is started, an output shaft (2311) of the starter motor (231) drives the input gear (2321) to rotate at a same speed, the input gear (2321) and the output gear (2323) meshes with each other and perform a speed reduction movement, and the output gear (2323) drives the crankshaft (204) to rotate at a same speed through the clutch unit.

5. The garden tool according to claim 4, wherein the speed reduction unit (232) further comprises an energy storage member used for storing kinetic energy of the starter motor (231) and releasing energy to the crankshaft (204).

6. The garden tool according to claim 4 or 5, wherein the energy storage member is a coil spring or a torsion spring mounted on the output gear (2323), and a free end of the energy storage member is able to be rotated relatively to another free end of the energy storage member as the output gear (2323) being rotated.

7. The garden tool according to anyone of claims 1-6, further comprising a lithium-ion battery pack, wherein the lithium-ion battery pack is connected to the controller (21) and provides power supply for the fuel supply system (25), the ignition system (24), and the control system through the controller (21).

8. The garden tool according to claim 7, wherein the gasoline engine (2) comprises an engine block (201), the fuel supply system (25) and the ignition system (24) are disposed in the engine block (201), and the lithium-ion battery pack is detachably mounted on the engine block (201).

9. The garden tool according to claim 7 or 8, wherein the ignition system (24) comprises a boosting device (241), used for raising an output voltage of the power source to an ignition voltage.

10. The garden tool according to claim 9, wherein the boosting device comprises multi-stage boosting modules, and the output voltage of the power source is raised to the ignition voltage by the multi-stage boosting modules.

11. The garden tool according to anyone of claims 7-10, wherein the gasoline engine (2) comprises a crankshaft (204), and the starting system (23) comprises

a starter motor (231) and a speed reduction unit (232); wherein when the gasoline engine (2) starting, the starter motor (231) drives the crankshaft (204) to rotate through the speed reduction unit (232); wherein the lithium-ion battery pack is disposed at a side of the speed reduction unit (232), the crankshaft (204) is disposed at another side of the speed reduction unit (232) and relative to the lithium-ion battery pack, and the controller (21) is disposed under the power source.

12. The garden tool according to anyone of claims 3-6, further comprising a power section (11), a handle section (14) and a linkage section (12); wherein the controller (21) is disposed in the power section (11), and the operator (102) is disposed in the handle section (14) and/or the linkage section (12).

13. The garden tool according to claim 12, wherein the operator (102) comprises a control panel and at least two operation keys disposed on the control panel, and a convex portion (1026) is provided between two adjacent operation keys.

Patentansprüche

1. Gartenwerkzeug, umfassend einen Verbrennungsmotor (2), wobei der Verbrennungsmotor (2) ein Kraftstoffversorgungssystem (25) und ein Zündsystem (24) umfasst;

wobei das Gartenwerkzeug ferner ein Steuersystem umfasst, wobei das Steuersystem mindestens einen Sensor (22), der zum Sammeln eines Arbeitszustandssignals des Verbrennungsmotors (2) verwendet wird, und eine einzelne Steuerung (21) umfasst, die zum Empfangen des Arbeitszustandssignals und zum Steuern des Kraftstoffversorgungssystems (25) und/oder des Zündsystems (24) gemäß den empfangenen Arbeitszustandssignalen verwendet wird;
wobei das Kraftstoffversorgungssystem (25) umfasst:

einen Vergaser (254), umfassend einen Einlasskanal (2541);
eine automatische Choke-Steuereinheit (251), umfassend eine Choke-Welle (2515), ein Choke-Ventil (2511), das auf der Choke-Welle (2515) befestigt ist und zum Schließen und Öffnen des Einlasskanals (2541) verwendet wird, einen Choke-Aktuator (2512), **gekennzeichnet durch**
eine Choke-Übertragungseinheit, umfassend
eine passive Nocke (2514), die auf der Choke-Welle (2515) gelagert ist, und eine aktive Nocke (2513), die mit der passiven Nocke (2514) zusammenwirkt und mit einem Ausgangsende des Choke-Aktuators (2512) verbunden ist, wobei, wenn der Verbrennungsmotor (2) gestartet wird, sobald eine Umgebungstemperatur niedriger als ein voreingestellter Wert ist, die Steuerung den Choke-Aktuator (2512) so steuert, dass er vorwärts arbeitet, um den aktiven Nocken (2513) anzutreiben, um den passiven Nocken (2514) anzutreiben, um das Choke-Ventil (2511) zu schließen, und sobald das Choke-Ventil (2511) geschlossen ist, die Steuerung den Choke-Aktuator (2512) so steuert, dass er rückwärts arbeitet und zurückgesetzt wird, so dass der Choke-Aktuator (2512) von der Choke-Übertragungseinheit getrennt wird; und
eine automatische Kraftstoffdrossel-Steuereinheit (252), umfassend eine Drosselwelle (2526), eine Drossel (2521), die auf der Drosselwelle (2526) befestigt ist und zum Schließen und Öffnen des Einlasskanals (2541) verwendet wird, und ein Verriegelungsende (2527), das an einem Ende der Drosselwelle (2526) lokalisiert ist und mit der automatischen Choke-Einheit (251) zusammenwirkt, wobei, wenn die Drossel (2521) geöffnet ist, das Choke-Ventil (2511) ebenfalls zum Öffnen angetrieben wird, wodurch eine Verbindung zwischen der Drossel (2521) und dem Choke-Ventil (2511) erzielt wird.

2. Gartenwerkzeug nach Anspruch 1, wobei das Steuerungssystem einen zweiten Sensor (222), der zur Messung eines Rotationsgeschwindigkeitssignals des Verbrennungsmotors (2) verwendet wird, und einen dritten Sensor umfasst, der zur Messung eines zweiten Umgebungstemperatursignals verwendet wird, wobei die Steuerung (21) eine Zündspannung und/oder einen Zündvorverstellwinkel gemäß dem Rotationsgeschwindigkeitssignal und dem zweiten Umgebungstemperatursignal anpasst, wobei das Zündsystem (24) eine Verstärkungsvorrichtung (241) und eine Zündkerze (242) umfasst, die mit einem Ausgangsende der Verstärkungsvorrichtung (241) verbunden ist, wobei der Verbrennungsmotor (2) ferner ein Schwungrad (243) umfasst, und wobei der zweite Sensor (222) auf dem Schwungrad (243) angeordnet ist.

3. Gartenwerkzeug nach Anspruch 1 oder 2, wobei der Verbrennungsmotor (2) ferner ein Startsystem (23) umfasst, wobei das Steuersystem ferner ein Betätigungsmittel (102) umfasst, das dazu verwendet wird, von einem Benutzer physisch betätigt zu wer-

den, um ein Benutzerbefehlssignal auszugeben, und wobei die Steuerung (21) das Benutzerbefehlssignal empfängt und mindestens eine der folgenden Steueraktionen am Verbrennungsmotor (2) durchführt: Starten, Abflammen und Anpassen einer Kraftstoffzufuhrmenge basierend auf dem empfangenen Benutzerbefehlssignal.

4. Gartenwerkzeug nach Anspruch 3, wobei das Startsystem (23) einen Startermotor (231), eine Geschwindigkeitsreduktionseinheit (232) und eine Kupplungseinheit umfasst, und wobei der Verbrennungsmotor (2) eine Kurbelwelle (204) umfasst; wobei, wenn der Verbrennungsmotor (2) gestartet wird, der Startermotor (231) die Kurbelwelle (204) antreibt, um durch die Geschwindigkeitsreduktionseinheit (232) zu rotieren; wobei die Kupplungseinheit zur einseitigen Übertragung des Drehmoments des Startermotors (231) verwendet wird und zwischen der Geschwindigkeitsreduktionseinheit (232) und der Kurbelwelle (204) angeordnet ist; wobei die Geschwindigkeitsreduktionseinheit (232) ein Zahnradsatz ist, der ein Eingangszahnrad (2321), ein Ausgangszahnrad (2323) und mindestens ein Übertragungszahnrad (2322) umfasst, das zwischen dem Eingangszahnrad (2321) und dem Ausgangszahnrad (2323) angeordnet ist; wobei, wenn der Verbrennungsmotor (2) gestartet wird, eine Ausgangswelle (2311) des Startermotors (231) das Eingangszahnrad (2321) antreibt, damit es mit derselben Geschwindigkeit rotiert, wobei das Eingangszahnrad (2321) und das Ausgangszahnrad (2323) miteinander kämmen und eine Geschwindigkeitsreduktionsbewegung durchführen, und wobei das Ausgangszahnrad (2323) die Kurbelwelle (204) antreibt, damit sie über die Kupplungseinheit mit derselben Geschwindigkeit rotiert.

5. Gartenwerkzeug nach Anspruch 4, wobei die Geschwindigkeitsreduktionseinheit (232) ferner ein Energiespeicherbauteil umfasst, das zur Speicherung von kinetischer Energie des Startermotors (231) und zur Freigabe von Energie an die Kurbelwelle (204) verwendet wird.

6. Gartenwerkzeug nach Anspruch 4 oder 5, wobei das Energiespeicherbauteil eine Schraubenfeder oder eine Torsionsfeder ist, die auf dem Ausgangszahnrad (2323) befestigt ist, und wobei ein freies Ende des Energiespeicherbauteils relativ zu einem anderen freien Ende des Energiespeicherbauteils gedreht werden kann, wenn das Ausgangszahnrad (2323) gedreht wird.

7. Gartenwerkzeug nach einem der Ansprüche 1-6, ferner umfassend einen Lithium-Ionen-Akkupack, wobei der Lithium-Ionen-Akkupack mit der Steuerung (21) verbunden ist und über die Steuerung (21) eine Stromversorgung für das Kraftstoffversorgungssystem (25), das Zündsystem (24) und das Steuersystem bereitstellt.

8. Gartenwerkzeug nach Anspruch 7, wobei der Verbrennungsmotor (2) einen Motorblock (201) umfasst, wobei das Kraftstoffversorgungssystem (25) und das Zündsystem (24) in dem Motorblock (201) angeordnet sind und wobei der Lithium-Ionen-Akkupack abnehmbar auf dem Motorblock (201) befestigt ist.

9. Gartenwerkzeug nach Anspruch 7 oder 8, wobei das Zündsystem (24) eine Verstärkungsvorrichtung (241) umfasst, die dazu verwendet wird, eine Ausgangsspannung der Stromquelle auf eine Zündspannung anzuheben.

10. Gartenwerkzeug nach Anspruch 9, wobei die Verstärkungsvorrichtung mehrstufige Verstärkungsmodule umfasst, und wobei die Ausgangsspannung der Stromquelle durch die mehrstufigen Verstärkungsmodule auf die Zündspannung angehoben wird.

11. Gartenwerkzeug nach einem der Ansprüche 7-10, wobei der Verbrennungsmotor (2) eine Kurbelwelle (204) umfasst und das Startsystem (23) einen Startermotor (231) und eine Geschwindigkeitsreduktionseinheit (232) umfasst; wobei, wenn der Verbrennungsmotor (2) startet, der Startermotor (231) die Kurbelwelle (204) dazu antreibt, durch die Geschwindigkeitsreduktionseinheit (232) zu rotieren; wobei der Lithium-Ionen-Akkupack an einer Seite der Geschwindigkeitsreduktionseinheit (232) angeordnet ist, die Kurbelwelle (204) an einer anderen Seite der Geschwindigkeitsreduktionseinheit (232) und relativ zu dem Lithium-Ionen-Akkupack angeordnet ist, und die Steuerung (21) unter der Stromquelle angeordnet ist.

12. Gartenwerkzeug nach einem der Ansprüche 3 bis 6, ferner umfassend einen Leistungsabschnitt (11), einen Griffabschnitt (14) und einen Verbindungsabschnitt (12), wobei die Steuerung (21) im Leistungsabschnitt (11) angeordnet ist und das Betätigungsmittel (102) im Griffabschnitt (14) und/oder im Verbindungsabschnitt (12) angeordnet ist.

13. Gartenwerkzeug nach Anspruch 12, wobei das Betätigungsmittel (102) ein Steuerpaneel und mindestens zwei Betätigungsschlüssel umfasst, die auf dem Steuerpaneel angeordnet sind, und wobei ein konvexer Bereich (1026) zwischen zwei benachbarten Betätigungsschlüsseln vorgesehen ist.

Revendications

1. Un outil de jardinage, comprenant un moteur à essence (2), le moteur à essence (2) comprenant un système d'alimentation (25) en carburant et un système d'allumage (24) ;

l'outil de jardinage comprenant en outre un système de commande, le système de commande comprenant au moins un capteur (22) utilisé pour collecter un signal de condition de fonctionnement du moteur à essence (2) et un contrôleur unique (21) utilisé pour recevoir le signal de condition de fonctionnement et commander le système d'alimentation (25) en carburant et/ou le système d'allumage (24) en fonction des signaux de condition de fonctionnement reçus ;
le système d'alimentation (25) en carburant comprenant :

un carburateur (254), comprenant un passage d'admission (2541) ;
une unité de commande de starter automatique (251), comprenant un arbre de starter (2515), une vanne de starter (2511) montée sur l'arbre de starter (2515) et utilisée pour fermer et ouvrir le passage d'admission (2541), un actionneur de starter (2512), **caractérisé par le fait qu'**une unité de transmission de starter comprend
une came passive (2514) emmanchée sur l'arbre de starter (2515) et une came active (2513) coopérant avec la came passive (2514) et reliée à une extrémité de sortie de l'actionneur de starter (2512) ; lorsque le moteur à essence (2) est démarré, dès lors qu'une température ambiante est inférieure à une valeur prédéfinie, le contrôleur commande à l'actionneur de starter (2512) de travailler vers l'avant pour entraîner la came active (2513) afin d'entraîner la came passive (2514) à fermer la vanne de starter (2511), et une fois la vanne de starter (2511) fermée, le contrôleur commande à l'actionneur de starter (2512) de fonctionner en sens inverse et d'être réinitialisé, de sorte que l'actionneur de starter (2512) soit déconnecté de l'unité de transmission de starter ; et
une unité automatique de commande d'accélérateur (252), comprenant un arbre d'accélérateur (2526), un papillon (2521) monté sur l'arbre d'accélérateur (2526) et utilisé pour fermer et ouvrir le passage d'admission (2541), et une extrémité de verrouillage (2527) situé à une extrémité de l'arbre de papillon (2526) et coopérant avec l'unité de starter automatique (251) ; lorsque le papillon (2521) est ouvert, le starter (2511) est également entraîné pour s'ouvrir, réalisant ainsi une liaison entre le papillon (2521) et la vanne de starter (2511).

2. L'outil de jardin selon la revendication 1, dans lequel le système de commande comprend un deuxième capteur (222) utilisé pour mesurer un signal de vitesse de rotation du moteur à essence (2) et un troisième capteur utilisé pour mesurer un deuxième signal de température ambiante, le contrôleur (21) ajuste la tension d'allumage et/ou un angle d'avance à l'allumage en fonction du signal de vitesse de rotation et du deuxième signal de température ambiante, le système d'allumage (24) comprend un dispositif de suralimentation (241) et une bougie d'allumage (242) connectée à une sortie à l'extrémité du dispositif de suralimentation (241), le moteur à essence (2) comprend en outre un volant d'inertie (243), et le deuxième capteur (222) est disposé sur le volant d'inertie (243).

3. L'outil de jardinage selon la revendication 1 ou la revendication 2, dans lequel le moteur à essence (2) comprend en outre un système de démarrage (23), le système de commande comprend en outre un organe opérateur (102) utilisé pour être physiquement actionné par un utilisateur pour délivrer un signal utilisateur de commande, et le contrôleur (21) reçoit le signal utilisateur de commande et effectue au moins une parmi les actions de commande suivantes sur le moteur à essence (2) : démarrage, extinction et réglage d'une quantité d'alimentation en carburant sur la base du signal utilisateur de commande reçu.

4. L'outil de jardin selon la revendication 3, dans lequel le système de démarrage (23) comprend un démarreur (231), une unité de réduction de vitesse (232) et une unité d'embrayage, et le moteur à essence (2) comprend un vilebrequin (204) ; lorsque le moteur à essence (2) est démarré, le démarreur (231) entraîne le vilebrequin (204) en rotation à travers l'unité de réduction de vitesse (232) ; l'unité d'embrayage est utilisée pour transmettre un couple de transmission unidirectionnel du démarreur (231) et est disposée entre l'unité de réduction de vitesse (232) et le vilebrequin (204) ; l'unité de réduction de vitesse (232) étant un ensemble de roues dentées comprenant une roue dentée d'entrée (2321), une roue dentée de sortie (2323) et au moins une roue dentée de transmission (2322) disposée entre la roue dentée d'entrée (2321) et la roue dentée de sortie (2323) ; lorsque le moteur à essence (2) est démarré, un arbre de sortie (2311) du démarreur (231) entraîne la roue dentée d'entrée (2321) à tourner à la même vitesse, la roue dentée d'entrée (2321) et la roue dentée de sortie (2323) engrènent l'une avec l'autre et effectuent un mouvement de réduc-

tion de vitesse, et la roue dentée de sortie (2323) entraîne le vilebrequin (204) à tourner à la même vitesse par l'intermédiaire de l'unité d'embrayage.

5. L'outil de jardin selon la revendication 4, dans lequel l'unité de réduction de vitesse (232) comprend en outre un élément de stockage d'énergie utilisé pour stocker l'énergie cinétique du démarreur (231) et libérer de l'énergie vers le vilebrequin (204).

6. L'outil de jardin selon la revendication 4 ou 5, dans lequel l'élément de stockage d'énergie est un ressort hélicoïdal ou un ressort de torsion monté sur la roue dentée de sortie (2323), et une extrémité libre de l'élément de stockage d'énergie est apte à tourner par rapport à une autre extrémité libre de l'élément de stockage d'énergie lorsque la roue dentée de sortie (2323) est mise en rotation.

7. L'outil de jardin selon l'une quelconque des revendications 1 à 6, comprenant en outre un bloc de batterie lithium-ion, le bloc de batterie lithium-ion étant connecté au contrôleur (21) et fournissant l'alimentation électrique du système d'alimentation (25) en carburant, du système d'allumage (24) et du système de commande via le contrôleur (21).

8. L'outil de jardinage selon la revendication 7, dans lequel le moteur à essence (2) comprend un bloc moteur (201), le système d'alimentation (25) en carburant et le système d'allumage (24) sont disposés dans le bloc moteur (201), et le bloc de batterie lithium-ion est monté de manière amovible sur le bloc moteur (201).

9. L'outil de jardinage selon la revendication 7 ou la revendication 8, dans lequel le système d'allumage (24) comprend un dispositif survolteur (241), utilisé pour élever une tension de sortie de la source d'alimentation jusqu'à une tension d'allumage.

10. L'outil de jardinage selon la revendication 9, dans lequel le dispositif survolteur comprend des modules survolteurs à plusieurs étages, et la tension de sortie de la source d'alimentation est élevée jusqu'à la tension d'allumage par les modules survolteurs à plusieurs étages.

11. L'outil de jardinage selon l'une quelconque des revendications 7 à 10, dans lequel le moteur à essence (2) comprend un vilebrequin (204), et le système de démarrage (23) comprend un démarreur (231) et une unité de réduction de vitesse (232) ; lorsque le moteur à essence (2) démarre, le démarreur (231) entraîne le vilebrequin (204) en rotation à travers l'unité de réduction de vitesse (232) ; le bloc de batterie lithium-ion est disposé sur un côté de l'unité de réduction de vitesse (232), le vilebrequin (204) est disposé sur un autre côté de l'unité de réduction de vitesse (232) et par rapport au bloc de batterie lithium-ion, et le contrôleur (21) est disposé sous la source d'alimentation.

12. L'outil de jardinage selon l'une quelconque des revendications 3 à 6, comprenant en outre une section de puissance (11), une section de poignée (14) et une section de liaison (12) ; le contrôleur (21) étant disposé dans la section de puissance (11), et l'organe opérateur (102) est disposé dans la section de poignée (14) et/ou la section de liaison (12).

13. L'outil de jardin selon la revendication 12, dans lequel l'organe opérateur (102) comprend un panneau de commande et au moins deux touches de commande disposées sur le panneau de commande, et une partie convexe (1026) est prévue entre deux touches de commande adjacentes.

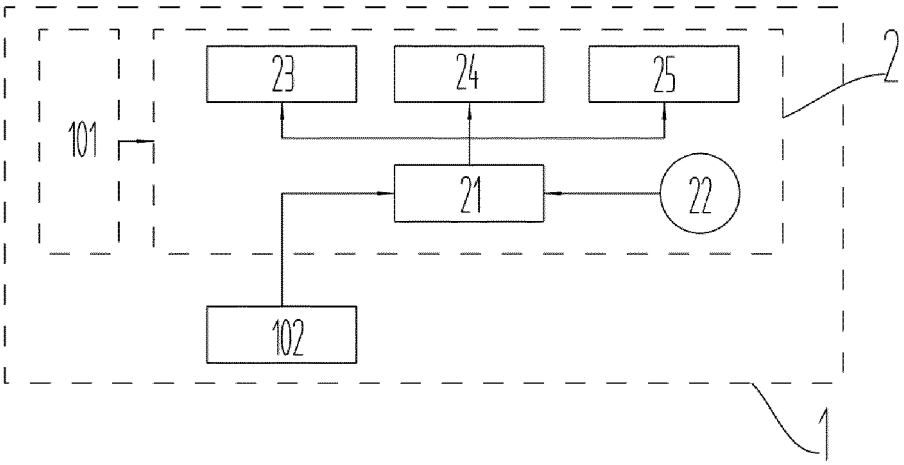

FIG. 1

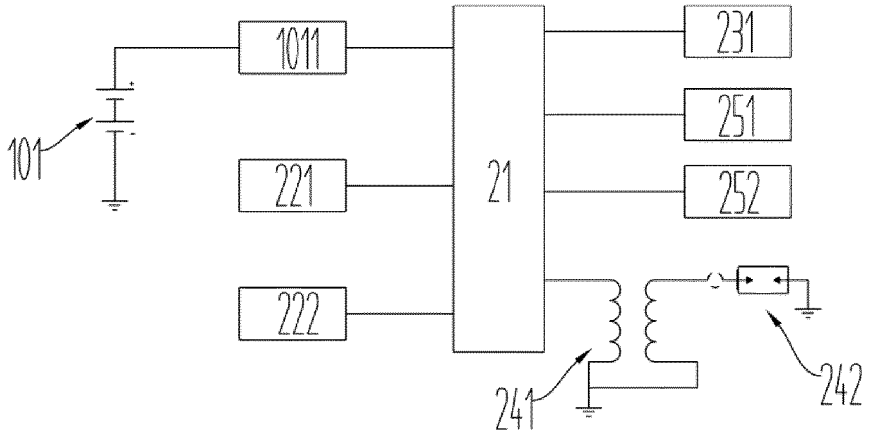

FIG. 2

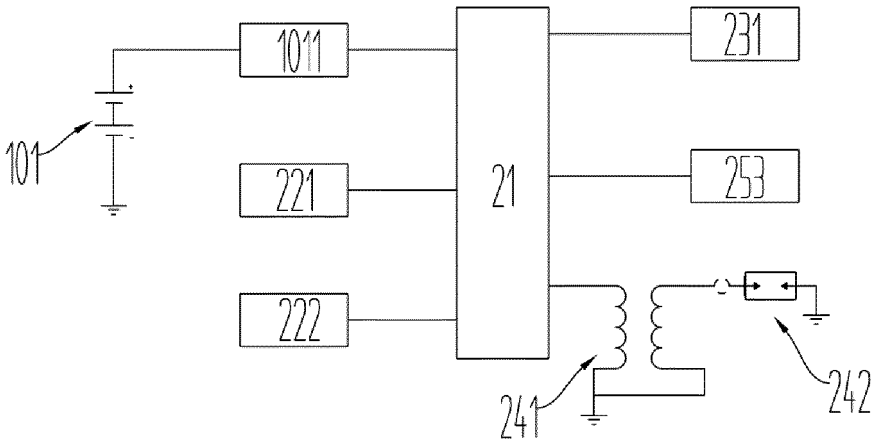

FIG. 3

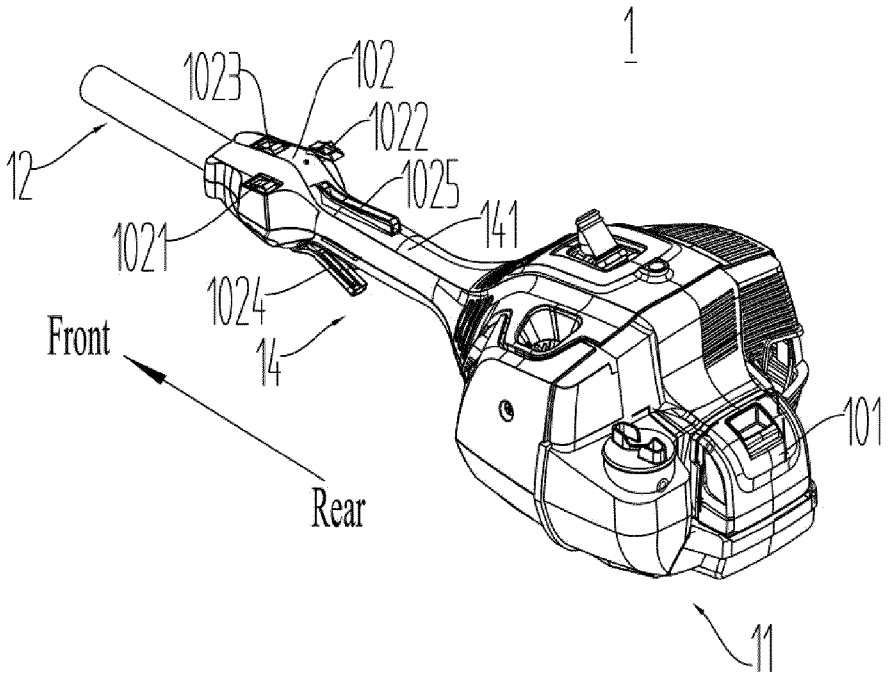
1
1023
102
1022
12
1025
141
1021
1024
Front
14
101
Rear
11

FIG. 4

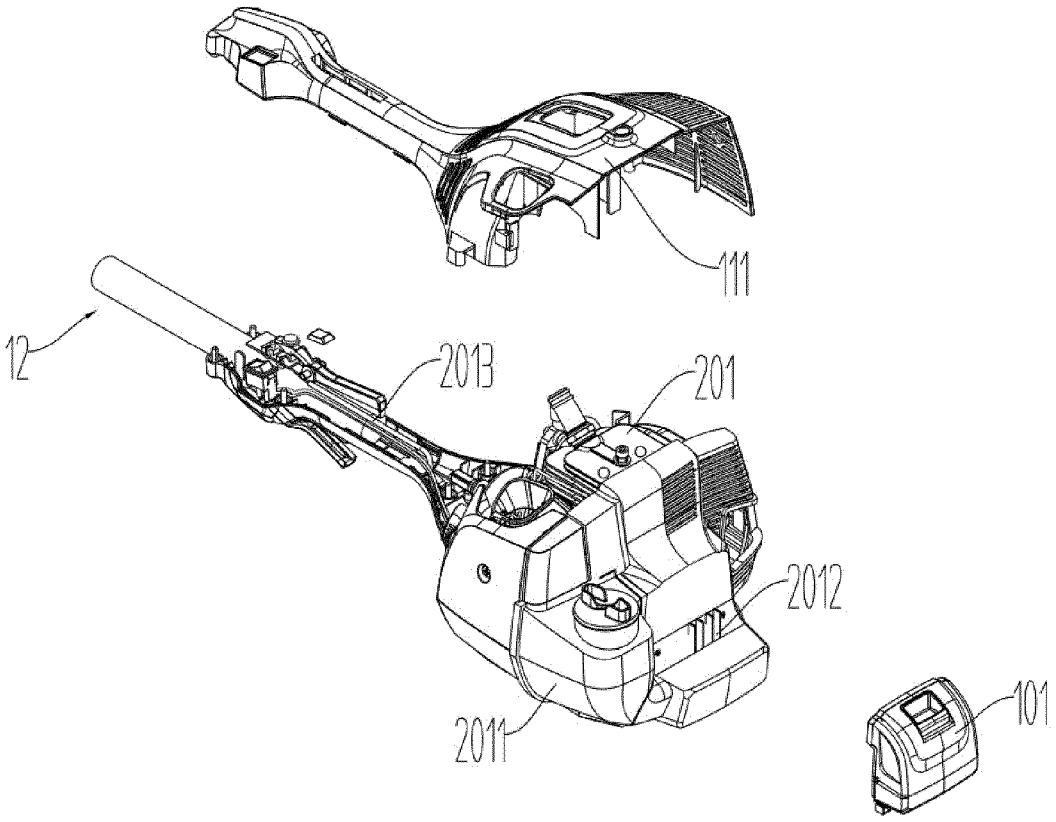
111
12
2013
201
2012
2011
101

FIG. 5

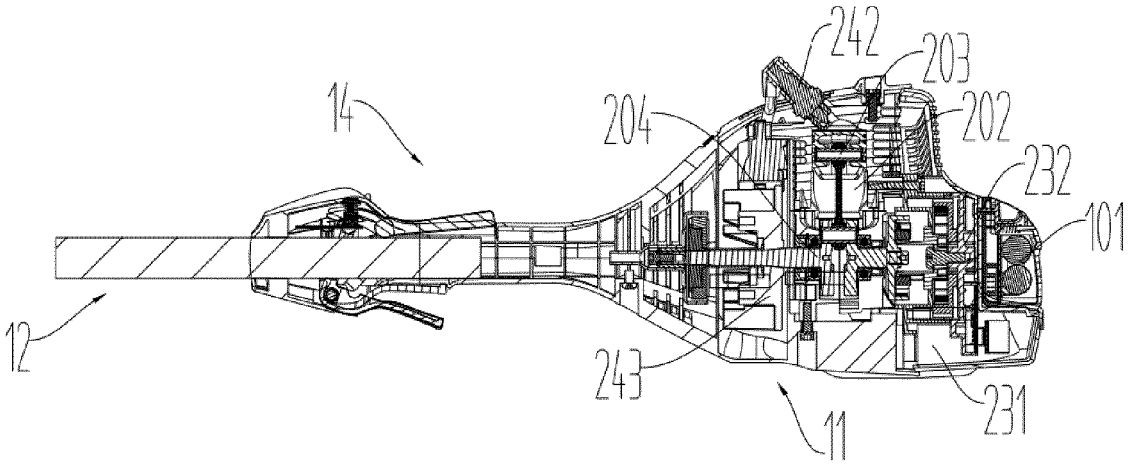
242
203
14
204
202
232
101
12
243
231
11

FIG. 6

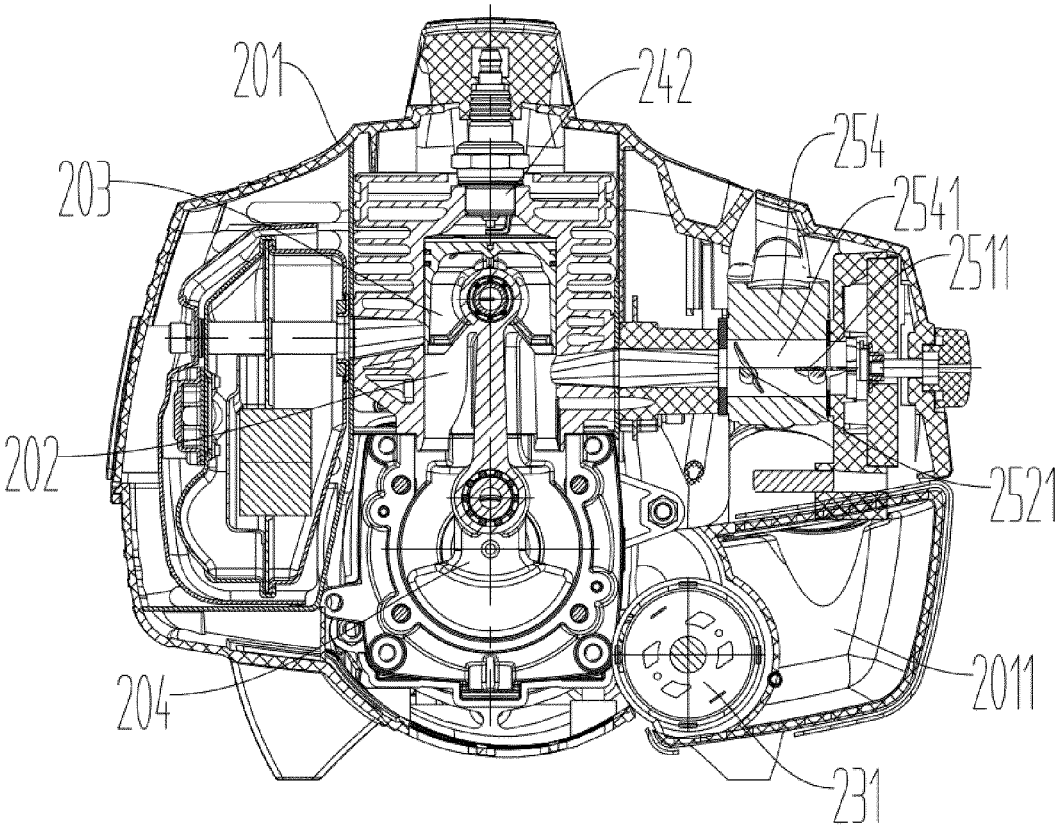
201
242
254
203
2541
2511
202
2521
2011
204
231

FIG. 7

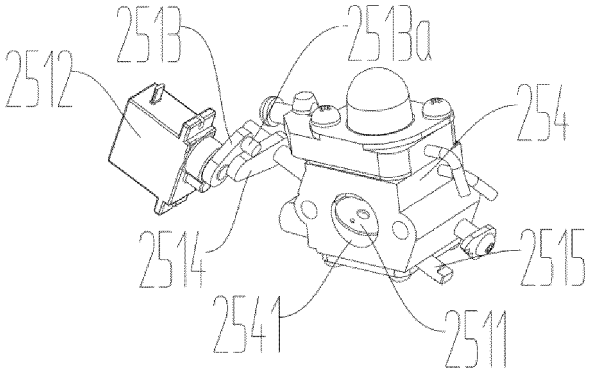

FIG. 8

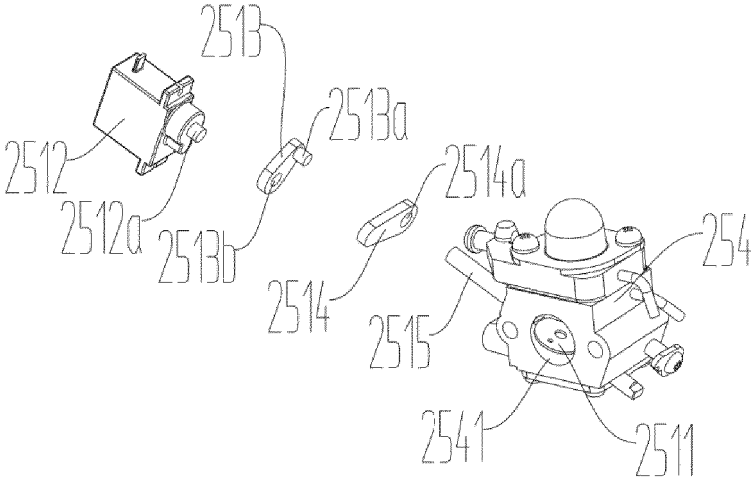

FIG. 9

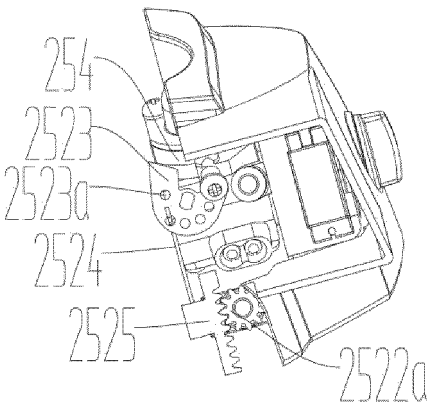

FIG. 10

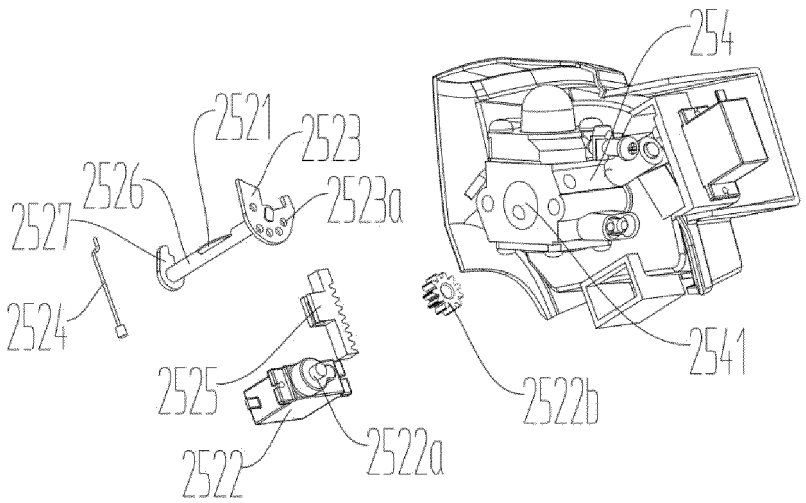
254
2521
2523
2526
2523a
2527
2524
2525
2522
2522a
2522b
2541

FIG. 11

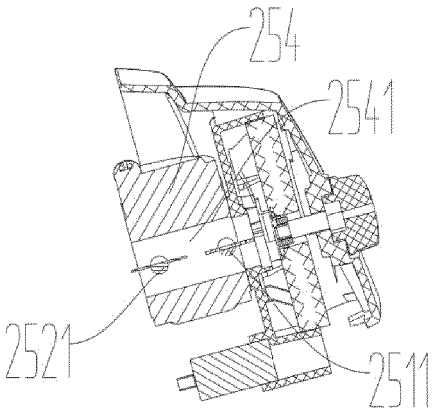
254
2541
2521
2511

FIG. 12

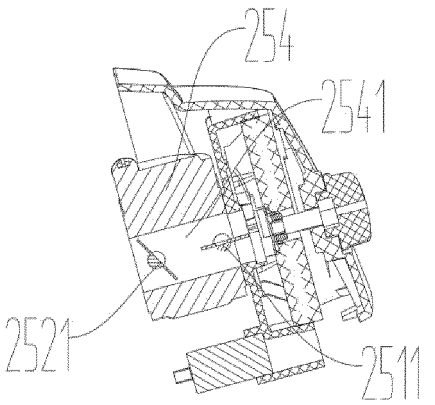
254
2541
2521
2511

FIG. 13

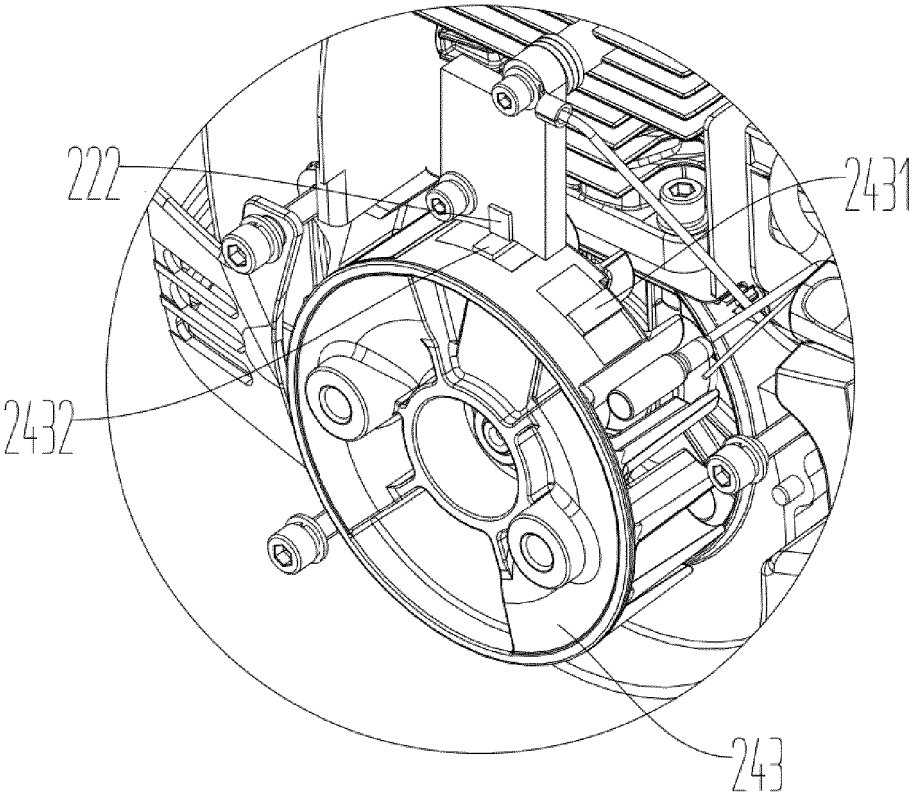

FIG. 14

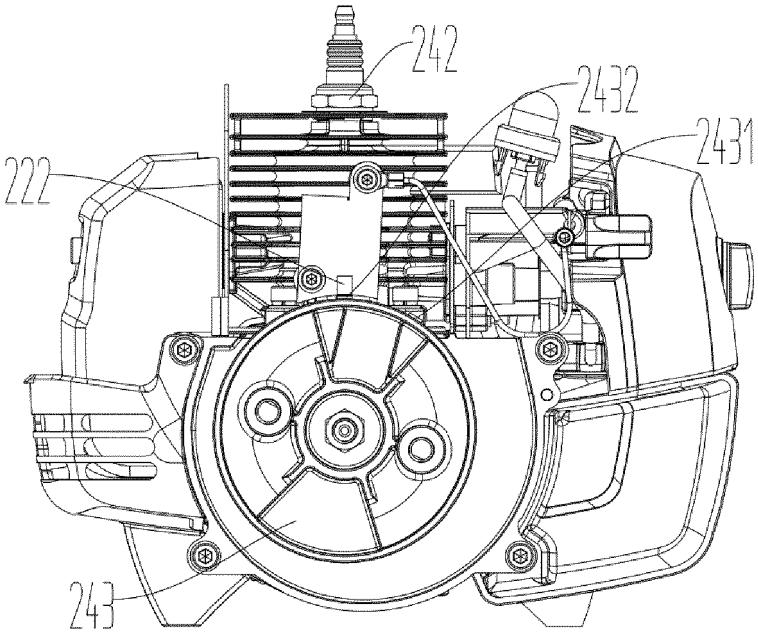

FIG. 15

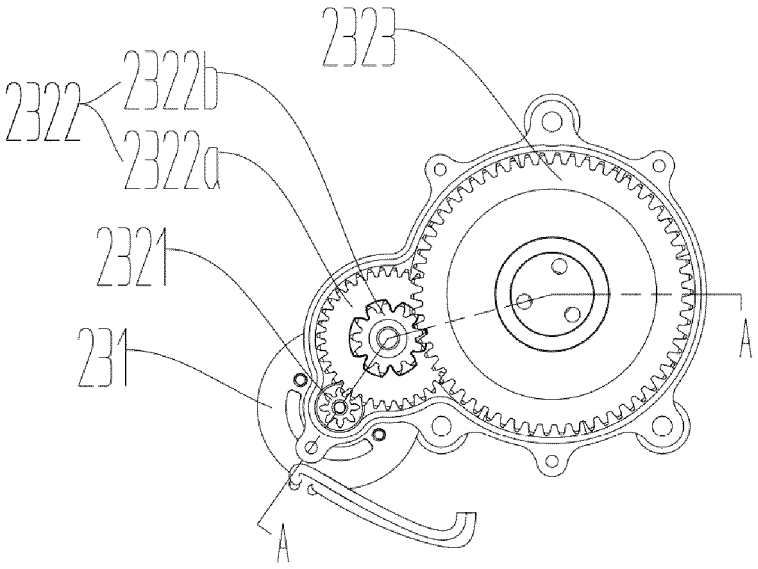

FIG. 16

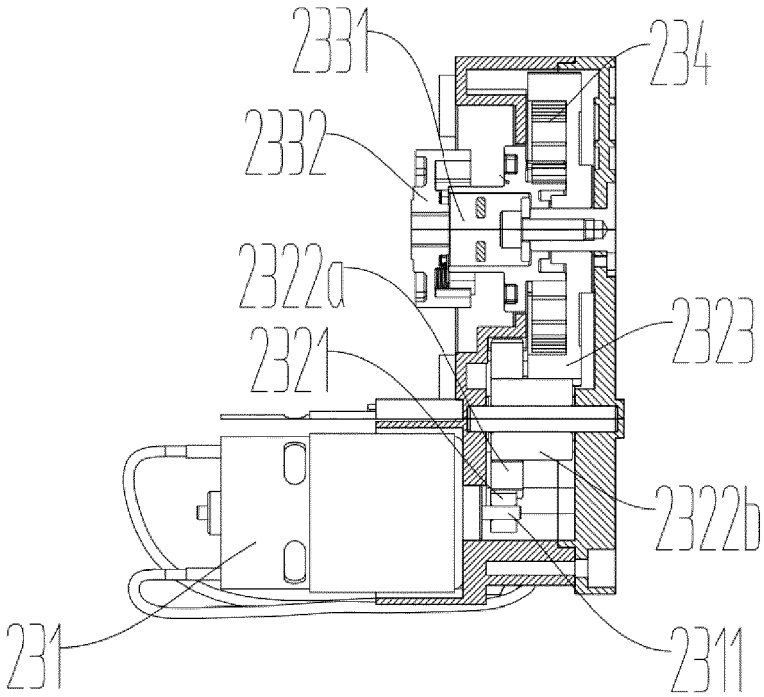

FIG. 17

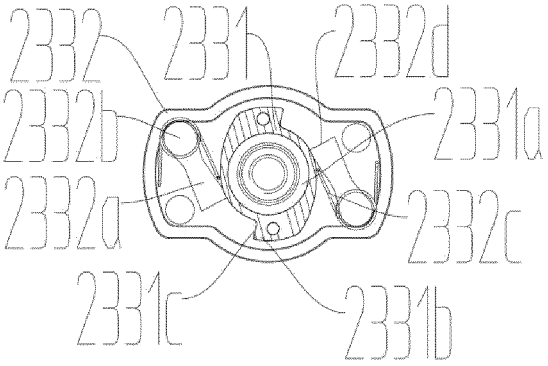
2332
2331
2332d
2332b
2331a
2332a
2332c
2331c
2331b

FIG. 18

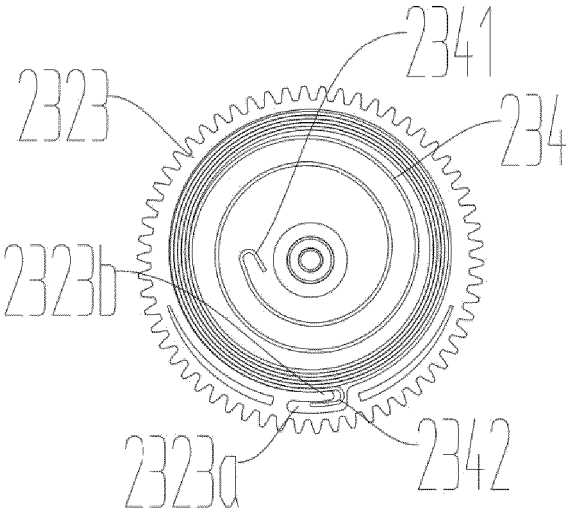
2341
2323
234
2323b
2323a
2342

FIG. 19

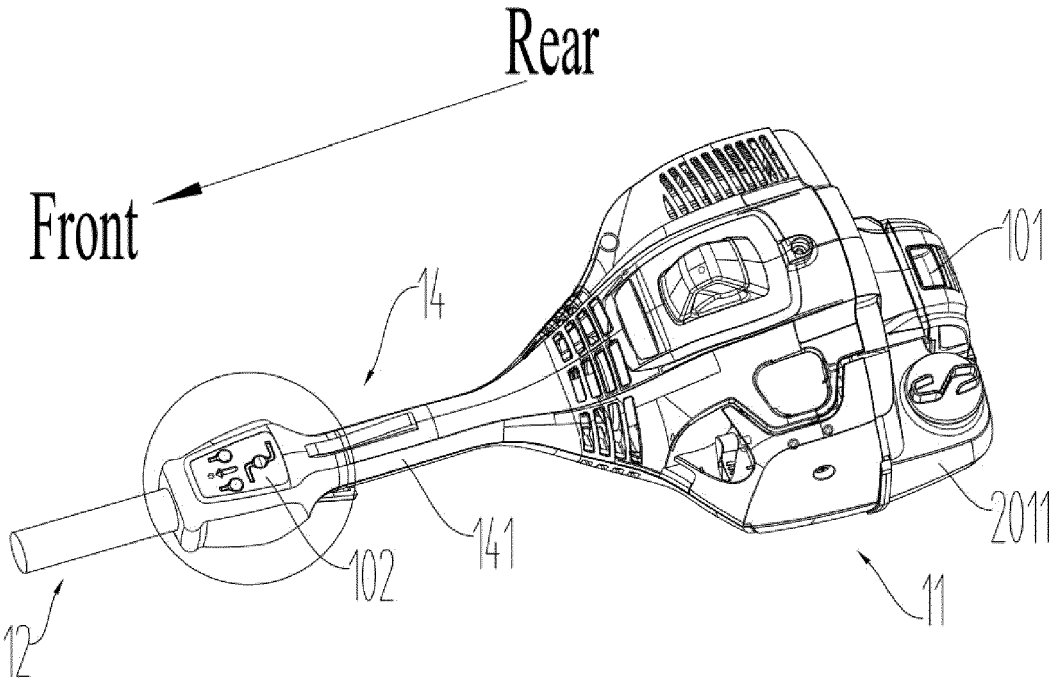
Rear
Front
14
101
102
141
2011
11
12

FIG. 20

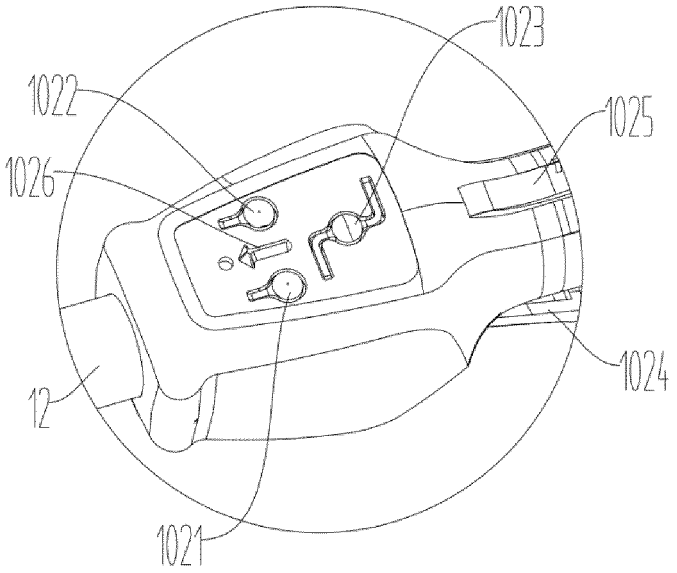
1023
1022
1025
1026
12
1024
1021

FIG. 21

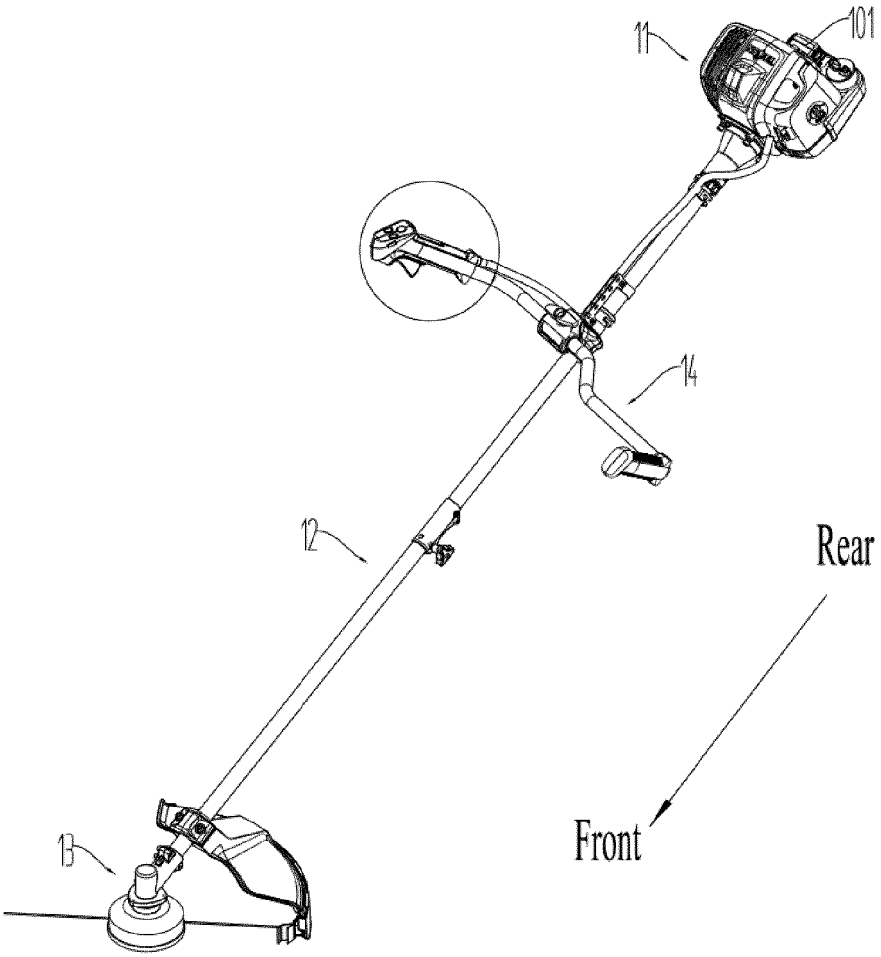

FIG. 22

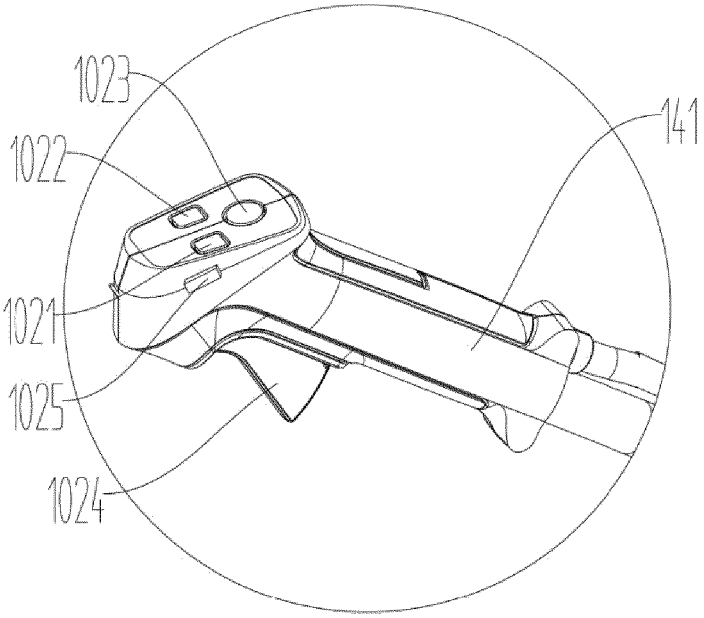

FIG. 23

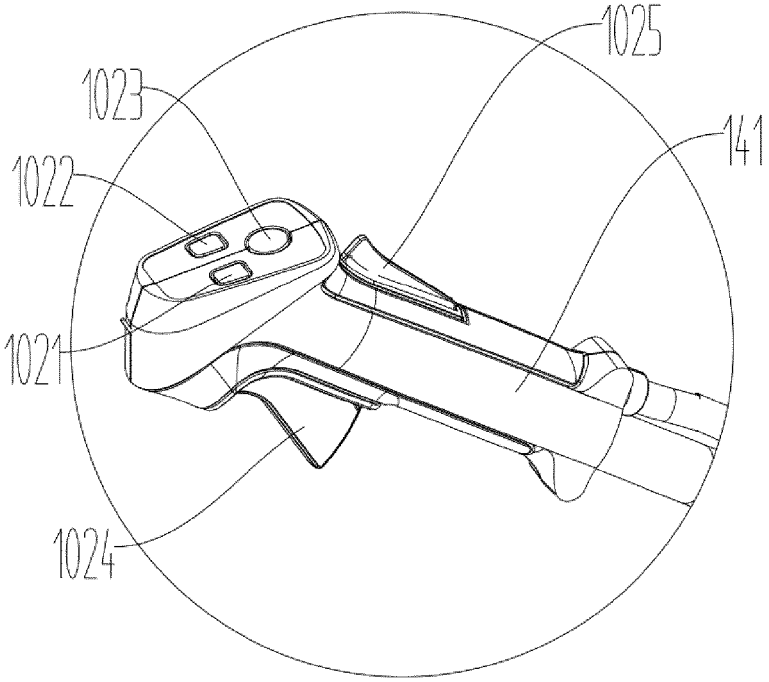

FIG. 24

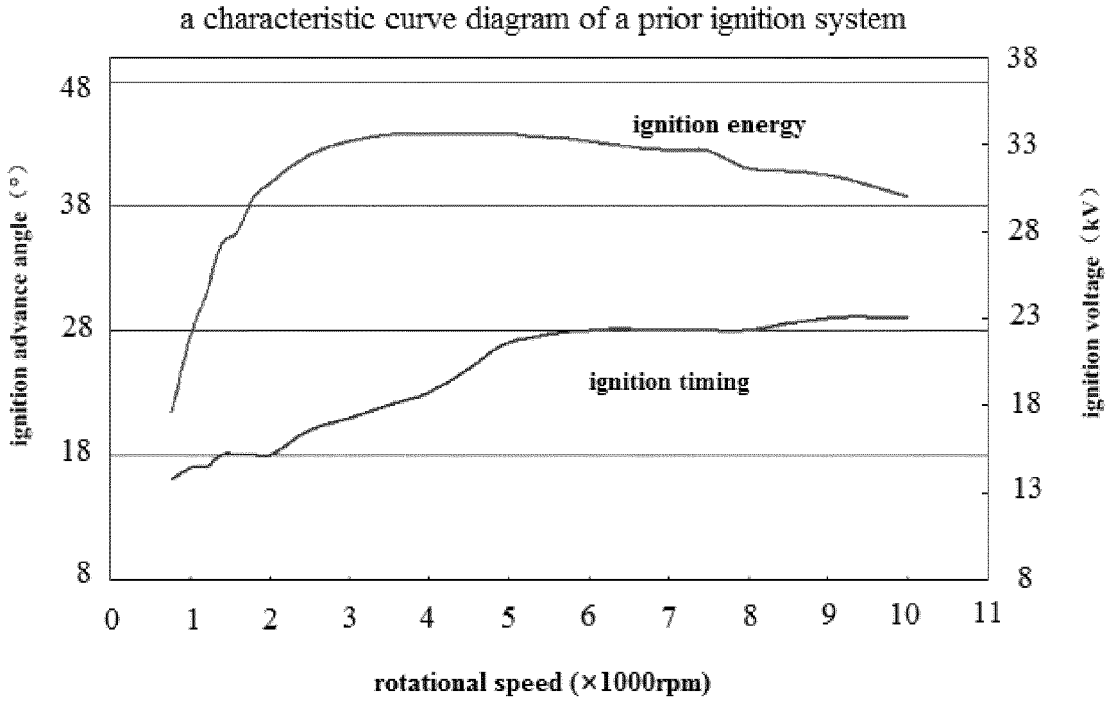
a characteristic curve diagram of a prior ignition system
ignition energy
ignition timing
ignition advance angle (°)
ignition voltage (kV)
rotational speed (×1000rpm)
48
38
28
18
8
38
33
28
23
18
13
8
0
1
2
3
4
5
6
7
8
9
10
11

FIG. 25

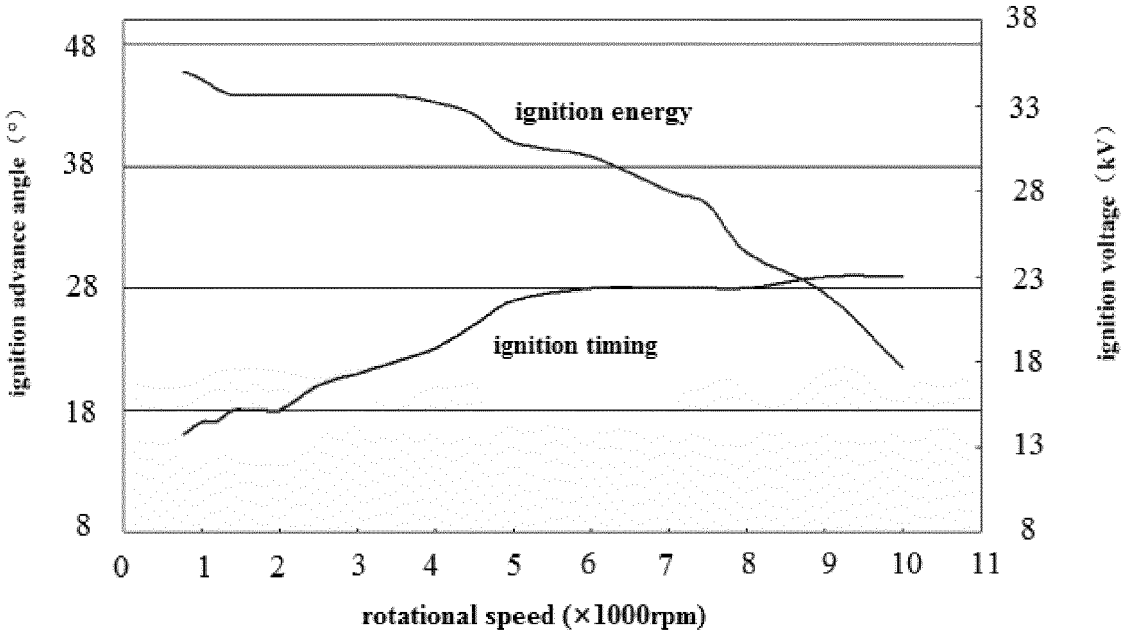
ignition energy
ignition timing
ignition advance angle (°)
ignition voltage (kV)
rotational speed (×1000rpm)
48
38
28
18
8
38
33
28
23
18
13
8
0
1
2
3
4
5
6
7
8
9
10
11

FIG. 26

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2128420 A2 **[0003]**